Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

B A S M A A

Bay Area

Stormwater Management

Agencies Association

P.O. Box 2385

Menlo Park, CA 94026

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September 16, 2013

Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Green Street Pilot Projects Summary Report - MRP Provisions C.3.b.iii and C.3.b.v.(2)(c)

Dear Mr. Wolfe:

This letter and attachment are submitted on behalf of all 76 municipalities subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP).

MRP Provision C.3.b.iii states:

> The Permittees shall cumulatively complete ten pilot green street projects that incorporate LID techniques for site design and treatment in accordance with Provision C.3.c and that provide stormwater treatment sized in accordance with Provision C.3.d. It is also desirable that they meet or exceed the Bay-Friendly Landscape Scorecard minimum requirements (see www.BayFriendly.org).
>
> (1) Parking lot projects that provide LID treatment in accordance with Provisions C.3.c and Provision C.3.d. for stormwater runoff from the parking lot and street may be considered pilot green street projects.
> (2) A Regulated Project (as defined in Provision C.3.b.ii) may not be counted as one of the ten pilot green street projects.
> (3) At least two pilot green street projects must be located in each of the following counties: Alameda, Contra Costa, San Mateo, and Santa Clara.
> (4) The Permittees shall construct the ten pilot green street projects in such a manner that they, as a whole:
> (a) Are representative of the various types of streets: arterial, collector, and local; and
> (b) Contain the following key elements:
> (i) Stormwater storage for landscaping reuse or stormwater treatment and/or infiltration for groundwater replenishment through the use of natural feature systems;
> (ii) Creation of attractive streetscapes that enhance neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods;
> (iii) Service as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, mainstreets, and wildlife habitats;

(iv) Parking management that includes maximum parking space requirements as opposed to minimum parking space requirements, parking requirement credits for subsidized transit or shuttle service, parking structures, shared parking, car sharing, or on-street diagonal parking;
(v) Meets broader community goals by providing pedestrian and, where appropriate, bicycle access; and
(vi) Located in a Priority Development Area as designated under the Association of Bay Area Government's and Metropolitan Transportation Commission's FOCUS4 program.

(5) The Permittees shall conduct appropriate monitoring of these projects to document the water quality benefits achieved. Appropriate monitoring may include modeling using the design specifications and specific site conditions

Due Date – All green street projects shall be completed by December 1, 2014.

Provision C.3.b.v.(2)(c) requires the Permittees to submit a report as follows:

(c) The 2013 Annual Report shall contain a summary of all green street projects completed by January 1, 2013. The summary shall include for each completed project the following information:

(i) Location of project

(ii) Size of project, including total impervious surface treated

(iii Map(s) of project showing areas where stormwater runoff will be treated by LID measures

(iv) Specific type(s) of LID treatment measures included

(v) Total and specific costs of project

(vi) Specific funding sources for project and breakdown of percentage paid by each funding source

(vii) Lessons learned, including recommendations to facilitate funding and building of future projects

(viii) Identification of responsible party and funding source for operation and maintenance.

Through the Bay Area Stormwater Management Agencies Association (BASMAA), the Permittees collaboratively developed the attached Green Street Pilot Projects Summary Report. Although monitoring is a component of more than half of the green street projects, a limited body of monitoring data is available as of the due date for this report; therefore, the report includes model-based estimates of pollutant removal by the projects.

Based on the information in this report and experience to date in the Bay Area, we would like to share the following observations and conclusions:

- Provision C.3.b.iii required the implementation of 10 green street pilot projects throughout the region. However, more than 20 such projects have been developed or are being developed during the term of the MRP (see Table A3 of the report for information regarding ten "additional" projects). For most of the projects, proponents indicated the project was initiated prior to adoption of the MRP, due to factors such as available funding, opportunity, and community goals and interests.
- Of the 20 projects, most projects were or will be at least partially funded by grants, and many received funding from multiple sources. (One project was funded solely by the local municipality, two projects were associated with private development projects, and one project was partially funded by private entities.). This further demonstrates the importance of the availability of additional sources of funding and opportunities for collaboration with other agencies beyond the local municipality in the success of a green street project.
- Although it is not explicitly stated in the report, among the most substantive lessons learned is that it is only possible to implement green street projects in developed areas when a fortuitous set of characteristics coincide. These include locations with favorable topography, adequate space within the right-of-way, an absence of irreconcilable utility conflicts, and a storm drain sufficiently close and deep to allow tie-in of treatment facility underdrains (if needed). Sites with this combination of features are limited.

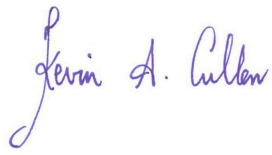
As the parties initiating, constructing, and maintaining green streets projects, the Permittees conclude that implementation of green streets (or "green infrastructure") can best be furthered not through permit provisions requiring development of green streets, but rather by facilitating grant funding, providing appropriate incentives in related sections of permits, and perhaps most importantly, working collaboratively with Permittees, transportation agencies, and state and federal agencies that provide water quality-related funding to better integrate green street objectives with transportation programs. Green street projects are most likely to occur in situations where a transportation project is already planned. Trying to acquire supplemental funding for green street features through grant solicitations that are not in sync with transportation funding programs and calendars is extremely challenging, at best.

We look forward to discussing with you and your staff the green street pilot projects, lessons learned thus far, and potential strategies to facilitate green streets projects on a larger scale. An informational slide show has been developed along with this report, and we would welcome the opportunity to share that presentation with you and your Board.

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matt Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program

Lance Barnett, Vallejo Sanitation and Flood Control District

Attachment: Green Street Pilot Projects Summary Report

cc: Tom Mumley, Regional Water Board
Shin-Roei Lee, Regional Water Board
Dale Bowyer, Regional Water Board
Sue Ma, Regional Water Board
BASMAA Board of Directors

Prepared for

Bay Area Stormwater Management Agencies Association (BASMAA)
P.O. Box 2385
Menlo Park, CA 94026

FINAL

Green Street Pilot Projects

Summary Report

Municipal Regional Permit Provision C.3.b.iii. and C.3.b.v.(2)(c).

Prepared by

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engineers | scientists | innovators

1111 Broadway, 6th Floor
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WW1436

7 August 2013

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1. EXECUTIVE SUMMARY

Municipal Regional Permit[1] (MRP) Provision C.3.b.iii requires that Permittees cumulatively complete ten green street pilot retrofit projects (Projects) that incorporate low impact development (LID) techniques for site design and treatment in accordance with Provision C.3.c and provide stormwater treatment sized in accordance with Provision C.3.d. At least two projects must be located in each of the following counties: Alameda, Contra Costa, San Mateo, and Santa Clara. Additionally, MRP Provision C.3.b.iii. (5) requires that the Permittees conduct appropriate monitoring of these projects to document the water quality benefits achieved. Appropriate monitoring may include modeling using design specifications and specific site conditions. The 2013 Annual Report, due to the Regional Water Board on September 15, 2013, must contain a summary of all green street pilot projects completed by January 1, 2013.

In fulfillment of MRP Provision C.3.b.v.(2)(c), this report, which is to be included with the 2013 Annual Report, provides project descriptions that include the locations of the ten selected green street pilot projects, the proposed treatment measures, drainage catchment information, project designs, construction activities, cost estimates, funding sources, and identification of parties responsible for operation and maintenance. The ten selected projects are in various stages of design and construction and will be completed within a few months of the report filing date. More than ten additional green street projects are in the planning and/or design phases throughout the San Francisco Bay Area, which are beyond the requirements of the MRP. In Appendix A, Tables A1 and A2 provide Project status tables that summarize key project information for the ten selected green street pilot projects. Table A3 provides available data on all of the reported twenty green street projects throughout the San Francisco Bay. The data indicate that most projects were at least partially funded by grants, and many received funding from multiple sources. (One project was funded solely by the local municipality, two projects were associated with private development projects, and one project was partially funded by private entities.)

For the selected projects with complete designs (i.e., the Codornices Creek Restoration Project and the Park and Hollis Stormwater Curb Extension Project), project design

[1] Municipal Regional Stormwater NPDES (National Pollutant Discharge Elimination System) Permit, Order R2-2009-0074, NPDES Permit No. CAS612008, issued by the California Regional Water Quality Control Board, San Francisco Bay Region.

drawings are provided in Appendix C. For the selected projects in the design stage (i.e., the Bransten Road Green Streets Project and the City of Richmond's San Pablo Avenue Green Spine Project), treatment measure conceptual plans are provided.

In fulfillment of MRP Provision C.3.b.iii.(5), a simple spreadsheet model was developed for the ten selected green street pilot projects using design specifications and site-specific considerations, including tributary area and land uses, rainfall, best management practices (BMP[2]) categorization, and runoff and effluent water quality. The list of potential pollutants of concerns (POCs) that were modeled included copper, zinc, total suspended solids (TSS), total mercury, and polychlorinated biphenyls (PCBs). Additionally, monitoring information is reported for those Projects where monitoring was conducted or is planned. Of the ten selected green street projects, one has been monitored and four others will be monitored following completion. Overall, more than half of the 20 reported green street projects have or will be monitored.

The ten green street pilot projects provide valuable lessons for the planning, design and construction of future green street projects. In general, constructing green street projects within an existing transportation corridor present major challenges. Right-of-ways generally contain electrical utilities, gas lines, water lines, and other infrastructure. Treatment facilities need adequate space within the right-of-way to operate effectively but cannot conflict with existing utilities and transportation needs, and must be located at a lower elevation than the tributary impervious surface for which treatment is desired. These factors require a comprehensive evaluation of the existing site and its functionality with accurate mapping and information prior to construction. In addition to technical considerations, factors such as availability of funding, opportunity for integration into other planned projects, and community support are key for the success of a green street project.

2. INTRODUCTION

MRP Provision C.3.b.iii. requires Permittees to cumulatively complete ten green street pilot projects (Projects) that incorporate LID techniques for site design and treatment in accordance with Provision C.3.c., and provide stormwater treatment sized in accordance

[2] The term "BMP" used throughout this report refers to a post-construction stormwater treatment measure.

with Provision C.3.d. At least projects must be located in each of the following counties: Alameda, Contra Costa, San Mateo, and Santa Clara.

The ten selected projects are representative of various types of streets, including arterial, collector, and local, as well as parking lots. As a whole, the Projects contain the following key elements as specified in Provision C.3.b.iii:

(i) Stormwater storage for landscape reuse or stormwater treatment and/or infiltration for groundwater replenishment through the use of natural feature systems;
(ii) Creation of attractive streetscapes that enhance neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods;
(iii) Service as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, main streets, and wildlife habitats;
(iv) Parking management that includes maximum parking space requirements as opposed to minimum parking space requirements, parking requirement credits for subsidized transit or shuttle service, parking structures, shared parking, car sharing, or on-street diagonal parking;
(v) Meets broader community goals by providing pedestrian, and where appropriate, bicycle access; and
(vi) Located in a Priority Development Area as designated under the Association of Bay Area Governments and Metropolitan Transportation Commission's FOCUS program.

This report fulfills the MRP requirements to provide the status of the ten green street pilot projects, as specified in Provision C.3.b.v. (2). This report contains a summary of all the projects completed by January 1, 2013, as well as those projects in the design phase that will be constructed by or near the end of the permit term. For each completed project, the summary includes the following information:

(i) The location of the project;
(ii) The size of the project, including the total impervious surface treated;
(iii) Map(s) of the project showing areas where stormwater runoff will be treated by LID measures;
(iv) Specific type(s) of LID treatment measures included;
(v) Total and specific costs of project;

(vi) Specific funding sources for project and breakdown of percentage paid by each funding source;
(vii) Lessons learned, including recommendations to facilitate finding and building of future projects; and
(viii) Identification of responsible party and funding source for operation and maintenance.

This report also documents the modeling methodology that was used to evaluate the potential water quality benefits achieved or proposed to be achieved by each of the ten green street pilot projects, as required in Provision C.3.b.iii.(5). The water quality benefits, in terms of potential removal of pollutants of concern (POCs), were estimated using a spreadsheet model and are described in Section 4 of this report. In general, the spreadsheet model errs on the side of conservatism in terms of inputs and assumptions and is not intended to evaluate actual BMP performance. The modeling results will be supplemented by more site-specific monitoring data for some projects (monitoring is planned for more than half of the twenty projects being implemented).

3. PROJECT DESCRIPTIONS

The project descriptions include available information on the locations of the green street pilot projects, the proposed treatment measures, drainage catchment information, project designs, construction activities, cost estimates, funding sources, and identification of parties responsible for operations and maintenance.

The ten selected projects are in various stages of design. For those projects with complete designs (i.e., the Codornices Creek Restoration Project and the Park and Hollis Stormwater Curb Extension Project), project design drawings are provided in Appendix C. For projects in the design stage (i.e., the Bransten Road Green Streets Project and the City of Richmond's San Pablo Avenue Green Spine Project), treatment measure conceptual plans are provided in Appendix C. In some cases, such as Bransten Road and Stanley Boulevard, the design plans are quite extensive, so a sample of bioretention cross-sections and plans showing treatment measure locations are provided, rather than including the entire design package. Figure 1 shows the locations of the ten selected green streets pilot projects and Appendix A provides Project status tables that summarize key Project information.

3.1 Park and Hollis Stormwater Curb Extension

The Park and Hollis Stormwater Curb Extension Project is located in the City of Emeryville (Alameda County), at the northeast corner of Park Avenue and Hollis Street. The project is classified as a landscaped curb extension along a collector street. The project was required by the City of Emeryville as part of an expansion project by Pixar Animation Studios. The project was completed in 2010 and is currently rated as a Bay-Friendly landscape (no score provided).

Project Catchment

The total drainage area to the Project is 0.19 acres. The Project is located in a commercially developed area and is entirely in the public right-of-way. Prior to construction, the tributary area was 100% impervious; following the installation of the curb extension, the tributary area became 93% impervious.

Treatment Measure Concept

The curb extension (bioretention facility) is 650 square feet in area and consists of an on-street planted rain garden with an underdrain. The underlying native soil is clay, so infiltration as the sole means of treatment was determined to be infeasible. Biofiltration media was added above the clay layer and an underdrain was installed to convey treated runoff to the public storm drain. The Alameda Countywide Clean Water Program's C.3 Stormwater Technical Guidance[3], which was used to size the treatment measure requires treatment measures to be a minimum of 4% of the tributary area.

Project Design and Construction Schedule

The Park and Hollis Stormwater Curb Extension Project was completed in 2010. Operation and maintenance activities are ongoing.

Project Funding and Costs

This project was entirely funded by Pixar Animation Studios as part of their expansion project. A request was submitted for detailed expense information for the green street portion of the project, but this data was not available at the time of reporting. The property on which the green street project is located is owned by the City of Emeryville.

[3] The ACCWP C3 Technical Guidance Manual can be found at http://www.cleanwaterprogram.org/c3-guidance-table.html?view=item

Project Outcomes and Lessons Learned

The Park and Hollis Stormwater Curb Extension Project was considered a success as a green street pilot project due to a reduction in localized flooding and the addition of vegetation that aesthetically enhanced the plaza area. A notable lesson learned from this project is that choosing streets with standard crowns, rather than those with steeper cross slopes, allows for more effective green streets due to the reduced cross slope and they allows for greater available treatment area. The project team recommended that green streets components should be a condition of approval for projects in Emeryville whenever possible.

Operation and Maintenance

Pixar Animation Studios is responsible for the project's operation and maintenance, and has signed a standard stormwater O&M agreement with the City of Emeryville.

3.2 Codornices Creek Restoration Project

The Codornices Creek Restoration Project is located in the City of Albany (Alameda County), and is a joint project between the City of Berkeley, City of Albany, and the University of California; the primary purpose of the project is to restore lower Codornices Creek between the Union Pacific Railroad Tracks to the west and San Pablo Avenue to the east. As part of the overall restoration project, a series of rain gardens (bioretention facilities) were installed to treat stormwater runoff prior to entering Codornices Creek, which are described below.

Project Catchment

The total drainage area tributary to the project is 1.93 acres of impervious area (developed on top of clay soils). The area, which will remain 100% impervious following the restoration, is commercial and residential in land use with 60% of the area in the public right-of-way.

Treatment Measure Concept

The four rain gardens (bioretention facilities) have surface areas of 180 ft^2, 260 ft^2, 224 ft^2, and 425 ft^2. The facilities have an underdrain placed near the top of a 1-foot gravel drainage layer, which may allow for some incidental infiltration through the system. There are two treatment areas located on each side of the 6th Street, which are separated by a sidewalk providing access to the street. Facility sizing was based on the Alameda

Countywide Clean Water Program's C3 Stormwater Technical Guidance, but two of the four basins were restricted in size by site conditions, including driveway access requirements for semi-truck trailers, an existing shallow culvert crossing, and design parameters for improved pedestrian crossing.

Project Design and Construction Schedule

The planning phase for the Project took approximately 1 year, the design phase was approximately 6 months, and the actual construction took approximately 1 year, with the rain garden portion taking approximately 3 months to construct.

Project Funding and Costs

The Codornices Creek Restoration Project was funded entirely by a Proposition 50 River Parkways Grant that was awarded to the City of Albany. The $2.2 million dollar grant was intended for the restoration of the Creek between 6th Street and 8th Street. The cost of the four rain gardens was included within this grant and was estimated to be approximately $175,000 in total. The design phase cost approximately $35,000, and the construction cost approximately $140,000. The project required permitting from the Department of Fish and Game and the San Francisco Bay Regional Water Quality Control Board, but this did not add any additional costs.

Table 1. Costs for Codornices Creek Restoration Project

Project Phase	Description	Cost ($)	Notes
Design	Labor	35,000	Rain garden cost estimated as a part of the overall grant for the Creek Restoration Project.
Construction	Materials	140,000	
Total Cost	**Total**	**175,000**	

Project Outcomes and Lessons Learned

The Codornices Creek Restoration Project incorporated rain gardens in curb extensions that provided the added benefit of traffic calming in the creek crossing area. Overall, the comments received from the public have been very positive. However, the dense growth of planting on the southern rain garden cells caused water to back-up on the outer wall of the cells, which caused ponding in the gutter during larger storms. Outside of the undersized southwestern rain garden, the ponding extended into the driveway area of an adjacent business. To address this problem, the original plantings in the southwestern

rain garden were removed and replaced with other species. Additionally, a duct was placed beneath the sidewalk on the western side of Sixth Street, allowing for a connection between southwestern and northwestern rain gardens. Finally, and unfortunately, the overflow of the northwestern rain garden was lowered, substantially reducing the effective area and effective reservoir volume of the two western rain gardens. (Dan Cloak, Personal Communication, 2013)

Operation and Maintenance

The maintenance of the improvements related to the Codornices Creek Restoration Project is shared among the City of Albany, the City of Berkeley, and UC Berkeley through a Memorandum of Understanding (MOU). The bioretention areas were included in the MOU prior to construction, with the costs split among the agencies. The first year of maintenance for the four rain gardens was estimated to cost approximately $2,000; the total annual cost per year to maintain the restoration area is approximately $20,000 per year. The project includes a mandatory 5-year landscape-monitoring plan.

3.3 Stanley Boulevard Safety and Streetscape Improvement

The Stanley Boulevard Safety and Streetscape Improvement Project is located in Unincorporated Alameda County along a 3-mile stretch of Stanley Boulevard between the city limits of Pleasanton and Livermore. The Alameda County Public Works Agency is converting a 4-lane, high volume arterial street, which is currently a primarily industrial corridor, to a rural parkway setting. The overall project uses a variety of sustainable design concepts and improves the safety and aesthetics along Stanley Boulevard. The project is rated as a Bay-Friendly landscape with a score of 98. The project is currently under construction.

Project Catchment

The total drainage area to the project is approximately 33 acres, 90% of which is in the public right-of-way. The pre- and post-project tributary area imperviousness values are 80% and 78%, respectively. Exploratory borings identified the underlying soils as being generally alluvium consisting of silty sand with gravel and clayey sand with gravel.

Treatment Measure Concept

Two treatment measures will be constructed along Stanley Boulevard: (1) an infiltration trench and (2) a bioswale (bioretention facility). The infiltration trench is located on the northern side of Stanley Boulevard and is approximately 13,895 feet long and 4 feet

wide, with a 1-foot depth of backfilled gravel. The infiltration trench is designed to infiltrate all runoff from the water quality design storm. The bioswale is located on the south side of Stanley Boulevard and is approximately 13,895 linear feet long and 3 feet wide. The bioswale has a maximum of 18 inches of sandy loam media and a raised overflow structure that is 4 inches above grade. The Caltrans standards and Alameda Countywide Clean Water Program's C.3 Stormwater Technical Guidance were used to size the treatment measures.

Project Design and Construction Schedule

The duration of the Stanley Boulevard Safety and Streetscape Improvement Project was projected to be from September 2008 to September 2012. The project is currently in the construction phase and the construction of the two treatment measures has not yet started.

Project Funding and Costs

The total cost of the project is estimated to be $14,500,000 and was funded by a variety of sources. State Prop 1B and local funds are contributing 64.3% of the project costs, CEMEX and Vulcan Materials Companies are contributing 34.5%, the Bay Area Air Quality Management District Transportation for Clean Air Grant Funds are contributing 0.008%, and the StopWaste.org Bay Friendly Grant Funds are contributing 0.002%. A breakdown of the design and construction costs for the stormwater treatment measures was not available at the time of reporting.

Project Outcomes and Lessons Learned

The construction of the Stanley Boulevard and Streetscape Improvement Project is still in progress, so it is not yet possible to assess treatment performance and project execution. However, the anticipated ancillary benefits of the project include improved drainage and stormwater treatment; the conservation of energy and water associated with stormwater runoff; the introduction of native plant species and diversification of wildlife habitats; and the improvement of public safety for motorists, bicyclists, and pedestrians (including compliance with the Americans with Disabilities Act (ADA) requirements). Interpretive signage will be located throughout the project site to promote and educate the public about sustainability concepts.

An important lesson learned through the project planning phase and design phase is that roadway projects that incorporate treatment features should be located on relatively flat

terrain and have ample public right-of-way. Where there is limited right-of-way within a developed or urban area, treatment options become limited in type and size, resulting in reduced treatment effectiveness and higher project costs.

Operation and Maintenance

The Alameda County Public Works Maintenance & Operations Division will be responsible for the operation and maintenance of the project site.

3.4 El Cerrito Green Streets Project

The El Cerrito Green Streets Project is located in the City of El Cerrito (Contra Costa County). The project includes facilities at two locations along the major arterial of San Pablo Avenue: (1) the Eureka Rain Gardens at 10200 San Pablo Avenue and (2) the Madison Rain Gardens at 11048 San Pablo Avenue. This project was conceived as part of the larger San Pablo Avenue Streetscape Project, which adds low impact development (LID) elements to the pedestrian, bicycle, transit, and beautification improvements. The project is located inside the El Cerrito San Pablo Priority Development Area, as designated by the ABAG/MTC FOCUS program. The project was completed in 2010.

Project Catchment

The drainage area to the project is 1.33 acres, only including the area within the public right-of-way. The tributary area to the Madison Rain Garden is 0.39 acres and the tributary area to the Eureka Rain Gardens is 0.94 acres. There may be some additional runoff from adjacent properties, but this area was not included in the analysis. The tributary area is classified as 100% commercial, with approximately 99% imperviousness in the pre-project and post-project scenarios.

Treatment Measure Concept

The Eureka Rain Garden consists of a series of 12 individual rain gardens and the Madison Rain Gardens consists of a series of seven individual rain gardens. The individual rain gardens (bioretention facilities) are separated from each other to provide access between curbside parking and the sidewalk. The gardens collect street runoff through a series of depressed troughs that run from the street gutters into the gardens and convey water through a series of curb cuts. There are two curb cuts for each of the individual rain gardens, which are composed of a gutter depression of 0.10 feet and a

flow-through trough set at 90 degrees to the gutter that falls 0.10 feet along a 2.5-foot rain garden length.

Water that enters the gardens is stored in a shallow depression and may leave the structure through one of three pathways. The first pathway is via percolation through approximately 18 inches of sandy loam filter media to the underdrain connected to the public storm drain system. The second pathway is to exit the storage area through one of the curb cuts located at the down gradient end of the rain garden and flow into the adjacent rain garden structure. The third pathway occurs when stormwater in the rain garden storage area exceeds the elevation of the overflow outlets and is conveyed directly to the storm drain. The water that enters the overflow catch basin or exits a downstream curb cut without being treated in a subsequent rain garden is considered untreated bypass flow.

The Madison Rain Garden was designed to capture 0.38 acres of the overall tributary area (0.39 acres). The Eureka Rain Garden was sized to treat 0.64 acres of the overall tributary area (0.94 acres).

Project Design and Construction Schedule

The design phase occurred from 2008 through the end of 2009 and was a portion of the larger San Pablo Avenue Streetscape Project. The construction of the El Cerrito Green Streets Project was completed in August of 2010.

Project Funding and Costs

Approximately 78% of this project was funded by a federal American Recovery and Reinvestment Act (ARRA) grant administered through the State Water Resources Control Board that amounted to $392,000. Funds from the ARRA grant were split between the design/construction phase and the monitoring phase. The design/ construction phase of the grant totaled $215,295 and was provided to the City of El Cerrito as a sub-grantee. The monitoring funds were managed by the San Francisco Estuary Institute (SFEI) and results from that monitoring were reported by SFEI (2012).[4] Additional funding for the project was provided by the El Cerrito Redevelopment Agency and amounted to $108,832, which is 22% of the overall funding.

[4] Monitoring and Results for El Cerrito Rain Gardens, Gilbreath, Pearce, and McKee (2012).

The total design costs specific to the green streets portion of the project are unknown because the design was completed in conjunction with the larger San Pablo Avenue Streetscape Project. An estimate for the total construction cost is $324,127, which includes estimated construction management costs of $26,300, but does not include an estimated annual operation and maintenance (O&M) cost of $5,000. The total monitoring costs are estimated at $176,705.

Table 2. Costs for El Cerrito Green Streets Project

Project Phase	Description	Individual Cost ($)	Total Cost ($)	Notes
Design	Total	Unknown	Unknown	Completed as part of larger San Pablo Ave Streetscape Project.
Construction	Management	26,300	324,127	
	Other	297,827		
O&M	Annual	5,000	5,000	
Monitoring	Total	176,705	176,705	Through SFEI
Total Cost	**Total**	**500,832**	**500,832**	The total estimated cost does not include the annual O&M costs.

Project Outcomes and Lessons Learned

The El Cerrito Green Streets Project has been considered an overall success and has been well received by the local community, particularly the businesses that are adjacent to the project. Many members of the community appreciate the aesthetic component of the rain gardens; some have noted that they appreciate the scale of the treatment facilities and their impact on stormwater management.

One design issue that arose during the monitoring analysis was that some of the curb cuts did not convey water into the rain gardens very well. This is attributed, in part, to the location of the plantings in the rain garden with respect to the placement of the curb cuts. Following construction, additional soil mix was placed in a portion of each of the rain gardens. This raised the top of soil above the design elevation so that the functional area and reservoir volume of each rain garden were reduced by between one-third to one-half (Dan Cloak, Personal Communication, 2013). This, in addition to other factors, could have led to significant bypass, which, although not measured, was observed (A. Gilbreath, SFEI, Personal Communication, 2012).

Overall, the project design and construction was completed with few major issues or setbacks due to the thorough planning process and cooperation of the community at large. One major change order was needed after a 16-inch water line was discovered within the rain garden area due to a mapping error. This was resolved quickly with East Bay Municipal Utility District (EBMUD), with a cost of implementing protective measures of $16,000. The only other additional change that was not in the original scope was the incorporation of a concrete pad for mounting a water quality sampler that cost $5,600.

Operation and Maintenance

The City of El Cerrito is responsible for the operations and maintenance of the project and the estimated additional cost per year is approximately $5,000. The entire maintenance staff received training on the filter media and the Bay Friendly planting scheme.

3.5 San Pablo Avenue Green Spine – Richmond

The portion of the San Pablo Avenue Green Spine Project within the City of Richmond (Contra Costa County) is located along the major arterial of San Pablo Avenue, between McBryde Avenue and Andrade Avenue. The project is currently at 30% design and the City is committed to incorporating Bay-Friendly landscape into the design. The project is located inside a Priority Development Area, as designated by the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC) FOCUS program.

Project Catchment

The total drainage area is approximately 2.22 acres. Additional Project catchment information is unknown at this time.

Treatment Measure Concept

The proposed treatment measures consist of six bioretention areas consisting of three rain gardens and three curb extensions. The six bioretention areas have a total surface area of 4,625 ft^2. All six of the facilities will be located on the western side of San Pablo Avenue. Three facilities are located on the northwestern side of the intersection of McBryde Ave and San Pablo Ave. One facility is located on the southern side of Andrade Ave where it meets San Pablo Ave, and two facilities are located on the

northern side of the intersection. Further specifications for the treatment measures are not yet available because the project is currently in the 30% design phase.

Project Design and Construction Schedule

The San Pablo Avenue Green Spine Project is currently in the 30% design phase. The designs are anticipated to be completed by late summer 2013 and construction to begin in late summer/fall 2013. The design and construction cost estimates are not available at this time.

Project Funding and Costs

The Project is being funded entirely through a water quality grant administered by the San Francisco Estuary Partnership (SFEP). The construction portion of the funding is provided by the California Department of Transportation (Caltrans) (42.6%). The Project is supported by grants from USEPA's San Francisco Bay Water Quality Improvement Fund (7.2%) and the State of California's Integrated Regional Water Management Program (50.2%). The exact amount and breakdown of costs by phase have not been determined yet.

Project Outcomes and Lessons Learned

The Project is still in the design phase and has not reached a stage to evaluate outcomes or lessons learned at this time.

Operation and Maintenance

The City of Richmond will ultimately be responsible for the operation and maintenance of the project.

3.6 Sustainable Streets and Parking Lot Demonstration Project

The Sustainable Green Streets and Parking Lots Demonstration Project is in the City of Burlingame (San Mateo County) on Donnelly Ave between Primrose Road and Bellevue Avenue. The project incorporated stormwater treatment into the Public Parking Lot C Project by the City of Burlingame. This project was also intended to improve traffic circulation and add disabled accessible stalls, while maintaining the number of parking stalls. The project was completed in January 2011.

Project Catchment

The total drainage area to the project is 1.32 acres and consists of an existing parking lot, adjacent roadway, and building roofs. The pre-project imperviousness was 95%. The runoff from this area is routed into a rain garden, which adds 0.06 acres of landscaped area and results in a post-project imperviousness of 90%. The soil underlying the project is a mix of clayey loam, sandy loam, fine sand, and gravel.

Treatment Measure Concept

The proposed treatment measures consist of a 0.06 acre rain garden and a 0.01 acre planter box (curb extension, both of which function as bioretention facilities). Because the project location is not served by a storm drain system, the bioretention areas were constructed without an underdrain. A trench was included underneath the bioretention areas to detain runoff to increase the volume that infiltrates into the underlying soils.

The facilities were sized based on flow-based criteria to capture 0.2 inches per hour of rainfall intensity and to have a surface area of at least 4% of the tributary impervious area. The rain garden and curb extension are sized to handle a 0.2 in/hr rainfall intensity through the two facilities. The infiltration rate of the bioretention media is estimated to be 10 inches per hour.

Project Design and Construction Schedule

The Sustainable Streets and Parking Lots Demonstration Project was completed in January 2011. The planning and design phase for the project took approximately 9 months, which was followed by 4 to 5 months of construction.

Project Funding and Costs

The San Mateo Countywide Water Pollution Prevention Program, which is administered by the San Mateo County/City Association of Governments, provided $250,000 of funding for the project. The City of Burlingame also contributed to the Capital Improvement Project through the General Fund. The total cost of the project was approximately $270,000, which included $55,000 for project design and $215,000 for construction costs. It is estimated that roughly $6,500 per year will be needed for routine operations and maintenance costs.

Table 3. Costs for Sustainable Streets and Parking Lot Demonstration Project

Project Phase	Description	Cost ($)	Notes
Design	Total	55,000	The total estimated cost does not include the annual O&M costs.
Construction	Total	215,000	
O&M	Annual	6,500	
Total Cost	**Total**	**270,000**	

Project Outcomes and Lessons Learned

The Sustainable Streets and Parking Lots Demonstration Project achieved stormwater treatment and improved the drainage problems that had previously been an issue in the parking lot. The project also resulted in enhanced pedestrian and vehicle safety, and can be considered a successful integration of green street features into an existing development. There were some initial concerns by property owners about the project, but since its completion, the responses have been solely positive, including those from the City Council. The project will continue to engage the public through educational signage in the visible downtown location.

Some important lessons learned through the project design and construction phase are the following:

1. A 1-foot rock strip is beneficial to deter erosion along the rain garden;
2. A maintenance period following construction should be incorporated into the schedule;
3. Simple irrigation systems should be provided for vegetated treatment measures, where needed;
4. Facilities should be sited where storm drain systems currently exist or where underdrains can be extended to connect to the current system. If this is not feasible, incorporate overflow mechanisms, such as storm drain overflow piping where possible;
5. Prior to construction, the availability of the planned landscaped plantings should be verified;
6. Contractor qualifications should always be included in the specifications.

7. Project proponents should attempt to acquire sufficient funding for storm drain overflow piping and monitoring as part of the project.

Operation and Maintenance

The City of Burlingame is responsible for operation and maintenance of the project, which will be funded through the General Fund at a cost of approximately $6,500 per year.

3.7 Bransten Road Green Street

The Bransten Road Green Street Project is located in the City of San Carlos (San Mateo County) along Bransten Road, between Old Country Road and Industrial Road. The project is along a local street, in a location where elevated levels of PCBs have been identified through sediment monitoring. To the extent feasible, the proposed treatment measures will be sited at locations where the elevated concentrations were identified. The final design of the project was completed in February 2013 and construction is anticipated to begin in the summer of 2013.

Project Catchment

The drainage area to the Project is 0.54 acres (only including the impervious roadway surface areas draining to the bioretention facilities). Unidentified tributary areas may include drainage from other impervious sources, such as private properties, adjacent sidewalks, rooftops, or parking lots; these may contribute additional runoff to the facilities but are not incorporated into the calculation of facility size. The surrounding area is primarily industrial in land use and the imperviousness in the area prior to construction is approximately 95%. The project is underlain by a combination of fill and Holocene-age alluvial fan deposits. The soil type is hydrologic soil group (HSG) D, which is characterized by low infiltration rates and high runoff potential.

Treatment Measure Concept

The proposed treatment measures are nine bioretention areas that will be constructed in newly created curb extensions of various lengths. The San Mateo Countywide Water

Pollution Prevention Program (SMCWPPP) guidelines[5] were used, where feasible, for designing the bioretention areas.

Certain aspects of some of the bioretention facilities' designs deviate from the SMCWPPP guidelines due to utility conflicts and site restrictions. The SMCWPPP guidelines state that there should be an underdrain system in place where HSG D soils are present for bioretention areas. However, five of the bioretention areas are designed without underdrains either due to their location along a stretch of Bransten Road with no existing storm drain system (and no feasible addition or extension of the storm drain) or due to the depth of the existing storm drain system being too shallow to connect to the underdrain invert. These five bioretention areas also have soil depths of 12 inches, which deviate from the SMCWPPP guidance (minimum soil layer depth of 18 inches) due to utility conflicts. These areas without underdrains are designed to infiltrate through the biotreatment soil media and into the underlying soils.

The four remaining bioretention areas have underdrains with elevated orifices to allow for infiltration of the water that collects in the bottom of the rock layer. It should be noted that the design of Bioretention Area 7 includes an underdrain system that is routed around the existing drainage inlet and through Bioretention Areas 8 and 9, so that it can discharge to a storm drain with an invert that is low enough to connect to the underdrain. This was incorporated because Bioretention Area 7 is identified with elevated levels of PCBs, so additional efforts were necessary to attain a typical bioretention design in order to address the pollution reduction goal of the Project.

The "Simplified Sizing Method" from the SMCWPPP was used to determine whether the bioretention areas satisfy C.3 guidelines. This method requires that a bioretention area is at least 4% of the impervious surface area draining to that facility. All of the proposed facilities satisfy this criterion, and some have added capacity to handle additional runoff (where sources in addition to the roadway areas were identified).

Project Design and Construction Schedule

The Bransten Road Green Street Project completed its final design in March of 2013. Construction is anticipated to be completed by the MRP Provision C.3.b.iii due date of December 1, 2014.

[5] The SMCWPPP C.3 Technical Guidance Manual can be found at: http://www.flowstobay.org/bs_new_development.php#c3

Project Funding and Costs

Funding for the project comes from three sources: (1) 59% from grant funding through USEPA's San Francisco Bay Water Quality Improvement Fund; (2) 40% from grant funding through the San Mateo Countywide Water Pollution Prevention Program's Sustainable Green Streets and Parking Lots Program; and (3) 1% from a match from the Countywide Program. The 100% design cost estimate provides for a total project cost of approximately $535,600, with the design cost estimated at $156,000 and the construction costs estimated at $379,600. The design cost were high due to potholing to verify utility locations, redesign due to utility conflicts and challenges with PCB levels.

Table 4. Costs for Bransten Road Green Street Project

Project Phase	Description	Cost ($)	Notes
Design	Total	156,000	Anticipated O&M costs are unknown at this time.
Construction	Total	379,600	
Total Cost	**Total**	**535,600**	

Project Outcomes and Lessons Learned

The project is at the 100% design phase, but has not reached a stage to evaluate outcomes or lessons learned at this time.

Operation and Maintenance

The City of San Carlos will be responsible for the operation and maintenance of the project following completion. The costs of these activities are not yet determined.

3.8 Packard Foundation Green Street

The David and Lucile Packard Foundation Green Street is located in the City of Los Altos (Santa Clara County) on Second Street between Lyell Street and Whitney Street. The green street features were constructed in 2012 as part of the Packard Foundation's development of its new office building at 343 Second Street. (The runoff from the building and associated hardscape and parking lots is captured and treated by other stormwater treatment measures.) The green street portion of the project incorporates curbside flow-through rain gardens and corner bulb-outs to capture, treat and infiltrate runoff from adjacent impervious surfaces.

Project Catchment

The total drainage area to the rain gardens is 0.59 acres of impervious road and sidewalk areas. The project reduced the area of imperviousness from 100% to approximately 89%. The underlying soil type of the tributary area is sandy lean clay to clayey sand.

Treatment Measure Concept

The treatment measures consist of 20 rain gardens (bioretention facilities) along the north and south sides of Second Street and at the corners of Whitney Street and Second Street. The rain gardens along Second Street fit within the park strip between the sidewalk and the street, and range in size from 3.5 to 6.5 feet wide and 8 to 27.5 feet long, separated by street trees and sidewalk or driveway entrances. Their surface areas range from 30 to 164 square feet. They receive sidewalk runoff via sheet flow and street runoff through curb cuts. The two rain gardens at the corners of Whitney Street are shaped like bulb-outs from the curb and have a surface area of 110 square feet. The total surface area of the 20 rain gardens is 1834 square feet.

The rain gardens were designed based on the Santa Clara County Urban Runoff Pollution Prevention Program (SCVURPPP) C.3 Stormwater Handbook, using a design infiltration rate of 2 inches/hour. However, rain garden sizes were primarily determined by the available space within the public right of way.

Project Design and Construction Schedule

The project was constructed in 2012.

Project Funding and Costs

The funding and cost breakdown of the project is not known at this time.

Project Outcomes and Lessons Learned

The project was constructed in 2012, but the outcomes or lessons learned are not known at this time.

Operation and Maintenance

The Packard Foundation is responsible for operation and maintenance of the project.

3.9 Hacienda Avenue Green Streets

The Hacienda Avenue Green Street Project is located in the City of Campbell (Santa Clara County) on a segment of Hacienda Avenue that connects the San Tomas Area Neighborhood to Winchester Boulevard. The City is redeveloping Hacienda Avenue as a green street with proposed improvements including the installation of a new sidewalk, bike lanes, street trees; and bioinfiltration areas; narrowing the existing development area; and encouraging infiltration in open areas. The project will incorporate Bay-Friendly Landscape Design guidelines. The project is currently in the final design phase, with final design anticipated in September 2013.

Project Catchment

The total drainage area to the project is 22.7 acres and has an imperviousness of 74% prior to the green street improvements. The reduction of the width of the roadway by the project will reduce the imperviousness to 71%. The land use of the catchment is primarily residential. The underlying soils are fine sandy silt, silty sand, and gravely sand.

Treatment Measure Concept

The treatment measures to be implemented along Hacienda Avenue include the installation of approximately 80 bioinfiltration areas (bioretention with no underdrain) along both sides of the street, which will be landscaped with drought tolerant, native plants. They range in width from 5 to 20 feet, with an average length of 60 feet. The total surface area of the bioinfiltration areas is roughly 26,000 square feet. The infiltration rate of the underlying soil (3 feet below existing grade) is approximately 4 inches per hour. The treatment measures were designed using the combination flow and volume method as described in the SCVURPPP C.3 Stormwater Handbook.

Project Design and Construction Schedule

The project is currently in the final design phase (anticipated final design in September 2013), with construction set to begin in the summer of 2014.

Project Funding and Costs

The project received $2,000,000 in funding from the Bay Area Integrated Regional Water Management Plan (IRWMP), and $500,000 in funding from Caltrans (in the form of a Federal Grant under Community Development Transportation Program, with funds

originating from Federal Transportation Enhancement Fund). The total budget for the project is approximately $4,635,000. The City of Campbell is providing the remaining funds for this project.

Project Outcomes and Lessons Learned

The project is still in the design phase and has not reached a stage to evaluate outcomes or lessons learned at this time.

Operation and Maintenance

The City of Campbell will be responsible for the operation and maintenance of the project following completion. The costs of these activities are not yet determined.

3.10 Southgate Neighborhood Green Streets

The Southgate Neighborhood Green Streets Project is located within the Southgate neighborhood in the City of Palo Alto (Santa Clara County). This is a residential neighborhood consisting of single-family homes. The subdivision was developed in the 1920s with storm water runoff directed via surface gutter flow to a single drainage inlet connected to a piped storm drain system. Due to problems with street ponding in the neighborhood that arose over time as a result of the deterioration of gutter grades, the City of Palo Alto decided to retrofit the neighborhood to improve surface drainage and incorporate green street elements to improve water quality.

Project Catchment

The total area for the site is approximately 41.4 acres. Catchment delineation to each treatment measure is still being refined as part of final design.

Treatment Measure Concept

The proposed treatment measures include bioretention and biofiltration planters, porous pavement crosswalks, and a porous pavement “paseo” (pedestrian walkway connecting two streets). The bioretention planters will be incorporated into the street right-of-way and existing parkway strips (vegetated areas between the sidewalks and the streets). The project includes installation of 19 bioretention areas. The bioretention areas will be sited in locations that optimize the amount of tributary area draining to each system. The size and configuration of each bioretention area vary based on various constraints in the neighborhood, including physical conflicts with mature street trees, driveways, and

utility infrastructure. Bioretention facility surface areas will range from 5 to 9 feet in width and from 6 to 45 feet in length. The total surface areas of the bioretention areas is 3,524 square feet.

Porous pavers will be incorporated into crosswalks at four intersections in the neighborhood. The pavers will connect each adjacent corner with a 10-foot-wide crosswalk, creating nearly 8,712 square feet of pervious walkway as a part of the project.

Project Design and Construction Schedule

The project is currently in the final design phase, with construction set to begin in the fall of 2013.

Project Funding and Costs

The project is being funded entirely by the City of Palo Alto. The preliminary cost estimate for the design and construction of the project, including the bioretention planters, pervious paseo, pervious crosswalks, and approximately 475 linear feet of new storm drain, is $1.1 million (approximately $300,000 for design and $800,000 for construction). The actual costs are not available at this time.

Project Outcomes and Lessons Learned

The project is currently in the design phase and therefore has not yet reached a stage to conduct a post-implementation evaluation of outcomes or lessons learned at this time. However, some of the lessons learned in the design phase include: (1) soils and utilities should be researched early in the project schedule in order to understand site constraints; and (2) the project team should coordinate with residents in the neighborhood not only for their approval, but also to educate them, understand their concerns, and obtain feedback.

Operation and Maintenance

The City of Palo Alto will be responsible for the operation and maintenance of the project following completion. The cost of these activities is not yet determined.

3.11 Additional Green Street Projects

In addition to the ten selected green streets pilot projects described above, there are currently more than ten additional green streets projects in the planning or design

phases in the MRP Permittee area throughout the San Francisco Bay. These additional green street projects are beyond the requirements of the MRP and are being constructed based on the initiative of the municipality or funding agency. These additional projects are summarized in Table 5 below and Table A3 in Appendix A provides the available data on all of the reported twenty green street projects throughout the San Francisco Bay.

Table 5. Additional Ten Green Street Projects

Project Name	Project Location
1. Martha Gardens – Green Alleys Pilot Project	Alley between 2nd & 3rd St; Virginia & Martha St, San Jose, 95110
2. Nevin Avenue Improvements Green Streets	Nevin Avenue from 19th St to 27th St, Richmond CA 94804
3. Park Avenue – Green Avenue Pilot Project	Park Ave between Meridian Ave & Sunol St, San Jose, 95126
4. PG&E Substation	South 1st Street & Cutting Blvd, Richmond 94804
5. San Pablo Avenue Green Spine – Albany	San Pablo Ave & Monroe St, Albany 94706
6. San Pablo Avenue Green Spine – Berkeley	San Pablo Ave & Codornices Creek, Berkeley 94706
7. San Pablo Avenue Green Spine – El Cerrito (2 Project locations)	San Pablo Ave & Stockton Ave, El Cerrito 94530 San Pablo Ave & Moeser Ave, El Cerrito 94530
8. San Pablo Avenue Green Spine – Emeryville	San Pablo Ave & W MacArthur Blvd, Emeryville 94608
9. San Pablo Avenue Green Spine – Oakland	San Pablo Ave & 17th Street, Oakland, 94612
10. San Pablo Avenue Green Spine – San Pablo	13613 San Pablo Ave, San Pablo 94806

4. WATER QUALITY MODELING

MRP Provision C.3.b.iii requires that the Permittees conduct appropriate monitoring of the green street pilot projects to document the water quality benefits achieved.

Appropriate monitoring may include modeling using the design specifications and specific site conditions of the projects. The water quality modeling approach described below was selected to meet this requirement. The list of potential pollutants of concern to be modeled consisted of: copper, zinc, total suspended solids (TSS), total mercury and polychlorinated biphenyls (PCBs). In general, the spreadsheet model airs on the side of conservatism in terms of inputs and assumptions and is not intended to evaluate actual BMP performance. The modeling results are meant as placeholders until more site-specific monitoring data is collected.

Monitoring has been conducted at one green street project, the El Cerrito Green Street Project and is described in Section 5. Monitoring is planned as part of four other selected green street projects (additional projects will be added in the future), as part of grant requirements.

4.1 Facility Sizing Methodology

The treatment measures were sized using a simplified flow-based methodology in which the surface area of the BMP is sized to be 4% of the tributary impervious area. This sizing factor (0.04) is based on the ratio of the design rainfall intensity (0.2 inches per hour) to the design percolation rate of the biotreatment soil media (5 inches per hour, as required by Provision C.3.c.i.(2)(b)(iv)).

The planned BMP surface area and actual sizing factor (BMP surface area divided by tributary impervious drainage area to BMP) are presented in Table 6. The sizing factor for a few of the green street pilot projects was less than 0.04, because the projects are retrofit projects and had to work with space available for the BMPs.. However, due to the conservatism of treatment facility design built into the 4% sizing method (i.e. the method does not account for surface ponding, actual treatment soil infiltration rates, etc.), project facilities with a sizing factor of less than 0.04 may nonetheless capture and treat the C.3.d amount of runoff. Existing site constraints such as land availability and utility conflicts are examples of confining parameters, which affect the size and placement of water quality treatment measures.

Table 6. Planned BMP Size and Sizing Factor

Project Name	Planned BMP Surface Area (acre)	Sizing Factor[1,2] --
San Pablo Avenue Green Spine - Richmond	0.106	0.049
El Cerrito Green Streets	0.025	0.019
Codornices Creek Restoration	0.025	0.013
Park and Hollis Stormwater Curb Extension	0.015	0.084
Stanley Boulevard Safety and Streetscape Improvement	2.23	0.087
Sustainable & Parking Lots Demonstration	0.072	0.056
Bransten Road Green Street	0.104	0.203
Southgate Neighborhood Green Streets	0.010	0.002[3]
Packard Foundation	0.042	0.071
Hacienda Avenue Green Streets	0.596	0.026

Notes:
1 The sizing factor is the planned BMP surface area divided by the total tributary impervious area.
2 Available project tributary area delineations may not include all surfaces draining to the BMP, such as the adjacent paved surfaces or roofs; the sizing factors were based on the reported project information.
3 Tributary area information available for Southgate Neighborhood Green Streets includes all areas within the neighborhood, not just those delineated to drain onto green streets.

4.2 Modeling Methodology for TSS and Metals

The reductions in pollutant loads of total suspended solids (TSS) and metals that may be achieved by green street pilot projects stormwater treatment facilities, were modeled using a simple spreadsheet-based model.

The reduction in pollutant loads in a BMP is based on a combination of two factors: (1) the amount of water that is treated by the BMP and (2) the level of treatment received. The amount of water that is treated is commonly referred to as "captured" and the percent of mean annual flow that is treated is commonly referred to as "percent captured". When the capacity of the BMP to accept inflow is met, water will flow around the unit and is said to be "bypassed".

The amount captured by a bioretention facility depends on a number of factors including the catchment area and tributary imperviousness, the surface area of the infiltration bed, surface ponding volume, the media infiltration rate, void space in the underdrain layer, native soils infiltration rates, and evapotranspiration rates. The percent capture also depends on the precipitation patterns and runoff rates, and the time that is

required for the BMP to drain (or draw down) and regain capacity to capture runoff in anticipation of the next event. All other factors being equal, BMPs located in areas receiving more intense rainfall and rainfall with short inter-event separation times will achieve lower percent capture.

One of the primary factors affecting percent capture is the surface area of the bioretention unit. As indicated in Table 6, the unit sizes for the green street pilot projects vary substantially in terms of sizing factor, including three units that have sizing factors below 0.04 (the nominal sizing factor used in the Bay Area for new development projects). These smaller units will achieve a lower percent capture than those units with sizing factors over 0.04 will. In general, bioretention facilities that are properly designed and sized using the 0.04 sizing factor, should achieve percent capture in excess of 80%. However, given the substantially lower sizing factors for some of the facilities due to their design as retrofit projects, it was conservatively assumed that all of the facilities would achieve a 70% percent capture rate. It should be noted that the facilities might be sized in accordance to C.3.d. with the 70% capture rate due to the overall conservative nature of the treatment facility design in the guidance documents.

The influent pollutant load estimates were based on land use specific concentrations from the San Francisco Bay Area Stormwater Runoff Monitoring Data Analysis 1988-1995 (BASMAA, 1996). The industrial land use concentrations were an average of the available “Light Industrial” and “Heavy Industrial” land use categories, and the transportation concentrations were used for projects with tributary areas designated as within the public right-of-way.

The concentration used for total copper for “Residential” land uses was assumed to be a weighted estimate based on 25% of the area producing runoff concentrations similar to “Urban” land use and 75% of the area producing runoff concentrations similar to “Open Space” land use, as those were the only two categories with concentrations provided for total copper. A summary of the assumed land use specific concentrations is presented in Table 7.

Table 7. Land Use Specific Influent Concentrations

Land Use	Total Cu (µg/L)	Total Zn (µg/L)	Total TSS (mg/L)
Residential	19.5	188	85.9
Commercial	45	397	97.5
Industrial	45	365	135
Transportation	45	279	192

Each of the analyses assumed that the facilities would achieve 70% capture of the runoff volume, and scaled the removal of pollutants accordingly. Within the facilities, a range was used to estimate the pollutant reductions due to incidental infiltration and/or evapotranspiration of the captured volume (25%, 50%, and 75%) to account for variability in design and infiltration rates beneath the facilities. Similar assumptions were made in the LID Feasibility/Infeasibility Report prepared for BASMAA in 2011 (Geosyntec, 2011b), which noted that incidental infiltration in biotreatment measures was analyzed in a publication by Strecker, Quigley, Urbonas, and Jones (Strecker et. al., 2004). That study observed as much as 40 percent volume reduction through incidental infiltration. The Sustainable Green Streets and Parking Lot Demonstration Project (City of Burlingame) was also modeled to have 80% and 100% infiltration of the captured volume due to the specification in the project description that the BMP was designed to infiltrate. For all projects, the remaining pollutant loads associated with the volume that was not modeled as being infiltrated, were used as the influent loads being treated within the BMPs.

The 2012 International Stormwater BMP Database Summaries were used to evaluate the effluent event mean concentrations (EMCs) of TSS and total metals (copper and zinc) for bioretention facilities and bioswales (See Table 8). The bioretention facilities in the database are mostly characterized as bioretention cells that are not associated with flood conveyance, and all but 8 of the facilities have underdrains. Bioswales in the database are typically dry grassy swales (wetland swales are analyzed in the wetland channel BMP category).

The Database is generally quite robust in terms of the number and quality of data. For example, fourteen studies consisting of a total of 193 measurements of effluent TSS EMCs from bioretention facilities were considered when estimating the mean effluent

concentration. Similarly, a total of 354 individual measurements from 23 studies were analyzed to estimate the mean for bioswales.

The information from the Database was not filtered by location or climate of the facilities (i.e., in order to isolate facilities in semi-arid climates). Monitoring data for bioretention facilities includes facilities located in Delaware, Massachusetts, North Carolina, New Hampshire, Oregon, Pennsylvania, Virginia, Washington and Wisconsin; monitored bioswales were located in California, Florida, North Carolina, New Hampshire, Oregon, Texas, Virginia, Washington, and Wisconsin. In order to evaluate the representativeness of this data for application in California, a comparison of the effluent TSS EMCs with local monitoring data from the El Cerrito Project was conducted, and the comparison was quite good. Therefore, the application of the Database for bioretention BMPs in semi-arid climates, such as California, was deemed appropriate until data that is more representative becomes available.

Table 8. Estimated Mean Effluent Concentrations in Bioretention and Bioswales

Constituent	BMP Type	Effluent Concentration
TSS (mg/L)	Bioretention	17.70
	Bioswale	27.00
Total Cu (µg/L)	Bioretention	9.72
	Bioswale	10.10
Total Zn (µg/L)	Bioretention	27.70
	Bioswale	36.20

With the exception of the Stanley Boulevard Safety and Streetscape Improvement Project, the pollutant reductions due to treatment were calculated for the overall tributary area and design BMP volume for bioretention facilities. The Stanley Boulevard Safety and Streetscape Improvement Project specifies that 43% of the BMP area is a bioswale, so the effluent concentrations were estimated as partially attributed to bioretention and partially attributed to bioswales.

The total estimated removal from incidental infiltration and treatment is summarized for each of the projects in Appendix B.

4.3 Model Methodology for PCBs and Mercury

The approximate removal of PCBs and mercury could not be estimated using the same methodology as TSS and total metals because the International Stormwater BMP Database does not contain sufficient information on removal efficiencies for bioswales and bioretention facilities for those contaminants. In lieu of that information, a correlation was used between influent and effluent TSS concentrations to represent the treatment and removal of PCBs and mercury. This correlation is based upon a study conducted by the San Francisco Estuary Institute (SFEI) that looked at the contaminants and loadings of trace contaminants in an urbanized tributary in Hayward, California called Zone 4 Line A (Z4LA) (McKee et. al., 2011).

The water quality concentrations of the influent to the BMPs were estimated using land use particle-based event mean concentrations (EMCs), which were developed as part of a calibration and verification effort of the Regional Watershed Spreadsheet Model (RSWM) that was conducted by SFEI (SFEI, 2012). The approach uses pollutant of concern (POC) loads monitoring data that was collected from 21 mass emission stations in the Bay Area and uses statistical analyses and reverse optimization to estimate the concentrations of PCBs and total mercury (HgT) that originate within the different land uses in the upstream watersheds (McKee et. al., 2011).

The land use categories used for HgT include 1) old urban areas, 2) newer urban areas, and 3) undeveloped land (agriculture and open space). Urban areas are broken into two categories based on age of development because legacy pollutants, such as PCBs, depend on age of land use as well as land use type. For PCBs, two different land use category breakdowns were used to identify if a statistically significant relationship exists between PCBs and land use for the watersheds analyzed. The land uses common to both breakdowns include: 1) old (pre-1954) industrial areas, 2) old urban areas, 3) newer urban areas, and 4) undeveloped land (agriculture/open space). The land use categorizations were based upon available GIS layers and a previous study conducted by Greenfield et. al. that demonstrated a positive correlation between old industrual (before 1954) areas and PCBs and HgT (Greenfield et. al., 2010). Railroads were also analyzed for one set of model iterations as a specialized PCBs-associated land use. However, the inclusion of the railroad land use category did not generally improve the fit of the esimated concentrations and was inconsistent across watersheds, so the mean concentrations for the scenario without railroads is used. One watershed (Santa Fe Channel) was removed from the PCB concentration analysis after a skew towards high concentrations was observed. The optimization particle ratios for HgT and PCBs are presented in Table 9.

Table 9. Optimized Mean Particle Ratios for PCBs and HgT

Land Use Type	PCBs (µg/kg)[1]	HgT (mg/kg)[2]
Old Urban	150	0.63
New Urban	0.87	0.16
Old Industrial	2800	N/A
Agriculture/Open Space	20	0.14

Notes:

1. For PCBs, the four land use categories used from the RWSM EMC analysis include: 1) old (pre-1954) industrial areas, 2) old urban areas, 3) newer urban areas, and 4) undeveloped land (agriculture/open space).
2. For HgT, the three land use categories used from the RWSM EMC analysis include: 1) old urban areas, 2) newer urban areas, and 3) undeveloped land (agriculture/open space).

Limitations of Methodology

The particle ratios indicated in Table 9 were applied to convert influent solids concentrations to PCB concentrations. Since each project catchment contained a mix of land uses, a "catchment land use weighted" estimate of the particle ratio was applied to the effluent TSS to predict the effluent PCB concentration. It was assumed then that the effluent particle ratio was equal to the composite influent particle ratio, based on the reasoning that most of removals of PCBs would be in proportion to the removal of solids. Loading reduction estimates contained in this report reflect this assumption.

However, particle ratio data collected by SFEI at the El Cerrito Rain Gardens (Gilbreath et al, 2012) indicate that the mean effluent particle ratio at the inlet was 1.16 mg/kg, and only 0.13 mg/kg at the outlet. This suggests that PCBs are treated more effectively than solids (perhaps because of adsorption) or that the source of solids in the effluent may reflect mobilizing of solids from the media. Data from the Daly City Library Monitoring Study show a similar pattern; namely the post-installation PCB – SSC correlation is lower than that for the pre-installation data (David et al, 2011).

The implication for this report is that estimates of load reductions based on equality of particle ratios may result in lower estimates of load reduction (by as much as 10%), especially in those catchments where much of the land use is categorized by older industrial.

4.4 Summary of Modeling Results

The total estimated removal from incidental infiltration and treatment is summarized for each of the projects in Appendix B. Table B1 presents the results for the scenario with 25% incidental infiltration of the captured runoff volume, which was intended to be representative of systems designed with an underdrain and/or located on soils with poor infiltration capacity. The percent of the influent loads that is removed is between 55-62% for TSS, 55-64% for PCBs, 55-62% for HgT, and 18% for both copper and zinc. Table B2 presents the modeling results for the median case of 50% incidental infiltration. The percent of the influent loads that are removed is between 60-65% for TSS, 60-66% for PCBs, 60-65% for HgT, and is 35% for both copper and zinc. Table B3 presents the results for the scenario with 75% incidental infiltration of the captured runoff volume, which was intended to be representative of systems designed without an underdrain and located on soils with high infiltration rates. The percent of the influent loads that are removed for 75% incidental infiltration is between 65-67% for TSS, 65-68% for PCBs, 65-67% for HgT, and 53% for both copper and zinc. The modeling indicates that a higher degree of infiltration increases the removal of influent metal loads significantly, while only marginally increasing the removal of TSS, PCBs and HgT.

5. MONITORING

At the time of this report, monitoring had only occurred at the El Cerrito Green Streets Project. Qualitative observational monitoring was conducted during water years (WY) 2010 and 2011 to observe the construction of the project and the performance in the first year following implementation. Water Quality monitoring data collected by SFEI during WY 2012 were limited to 4 storm events and indicated that the percent reduction in concentrations (or treatment effectiveness) achieved varied depending on constituent, but was approximately 79% for suspended sediment concentration (SSC), 87% for polychlorinated biphenyls (PCBs), and 69% for total copper. Reductions in mercury were less consistent and the reduction for total Hg was indicated as -17%. This estimate was heavily driven by one sample, without which, the effectiveness would have been 32%. A summary table of the estimated load reductions is presented in Table 10.

Table 10. El Cerrito Green Streets - Estimated Load Reductions

	Average Change in Concentration (Inlet-Outlet)	Load Reduction if Volume Reduced by:		
		25%	50%	75%
SSC (n=4)	79%	84%	90%	95%
HgT (n=4) [1]	-17%	12%	42%	71%
HgT (excluding Storm 2; n=3) [1]	32%	49%	66%	83%
Total Copper (n=4)	69%	77%	85%	92%
PCBs (n=4)	87%	90%	94%	97%

Notes:
1. HgT is presented, both including all the data, as well as excluding the anomalous Storm 2 data point.

Monitoring is planned for the Codornices Creek Restoration Project, the San Pablo Avenue Green Spine Project, the Bransten Road Green Street Project, and the Hacienda Avenue Green Streets Project. A monitoring plan has been developed for the City of Richmond's San Pablo Avenue Green Spine Project and the Hacienda Avenue Green Streets Project as part of the Green Infrastructure Capacity Building Project, managed by the San Francisco Estuary Partnership (SFEP). The San Francisco Estuary Institute (SFEI) will conduct pollutant and flow monitoring to determine the effectiveness of the stormwater treatment measures to meet the green infrastructure implementation goals.

The San Pablo Avenue Green Spine project includes seven locations, one of which is the selected green streets pilot project located in the City of Richmond. The seven planned project locations will be assessed to determine the three locations most appropriate for monitoring with respect to site logistics, land use characteristics, and green infrastructure type. Baseline conditions will be established using land use characteristics in the drainage areas for each delineated project site and inlet monitoring prior to the stormwater reaching the treatment mechanisms for three storm events. The outlet of the facilities will also be monitored to provide an estimate of the level of treatment achieved. The preliminary analyte list includes PCBs, PAHs, mercury (total and dissolved), copper (total and dissolved), nutrients, and SSC.

The Hacienda Avenue Project will be monitored to evaluate its water budget by measuring the rainfall, stormwater bypass, and the water level within the treatment facility. This will allow for an estimation of infiltration to determine whether the facility is functioning as designed.

Finally, the Bransten Road Green Street Project will be monitored as part of Clean Watersheds for a Clean Bay (CW4CB) Task 5 grant in two phases: a screening phase to support monitoring design (2012-13 wet season) and a BMP assessment phase (2013-14 wet season). A maximum of 19 stormwater samples will be collected. A lesser number may be collected depending on the number of storms that are monitored during the 2012-2013 wet season. Grab samples will be collected for the following pollutants of concern: PCBs, dissolved PCBs, total mercury, particle size distribution, volatile suspended solids (VSS), suspended sediment concentration (SSC), turbidity, and settleable solids.

6. SUMMARY OF LESSONS LEARNED

The ten green street pilot projects provide valuable lessons for the design and construction of future green street projects. In general, constructing green street projects within an existing transportation corridor present major challenges. Right-of-ways generally contain electrical utilities, gas lines, water lines, and other infrastructure. Treatment facilities need adequate space within the right-of-way to operate effectively but cannot conflict with existing utilities and transportation needs, and must be located at a lower elevation than the tributary impervious surface for which treatment is desired. These factors require a comprehensive evaluation of the existing site and its functionality with accurate mapping and information prior to construction.

Additionally, runoff from areas outside of the delineated tributary area, such as adjacent properties, rooftops, sidewalks, and parking lots, may drain to green street project treatment measures even though they are not sized to treat the additional flows. Unanticipated treatment benefits from treating the additional runoff will be achieved even if the areas outside of the right-of-way are not designed to be tributary to the treatment measures.

Additional design and construction lessons learned include: (1) special attention should be made to design the curb cuts so that significant bypass does not occur; (2) Standard crown slopes allow for more effective implementation of green streets due to the reduced cross slope and greater available treatment area; (3) Monitoring of the facility should be considered during the design phase so that the appropriate infrastructure can be built; (4) the project team should coordinate with residents in the neighborhood not only for their approval, but also to educate them, understand their concerns, and obtain

feedback; and (5) A maintenance period following construction should be incorporated into the schedule.

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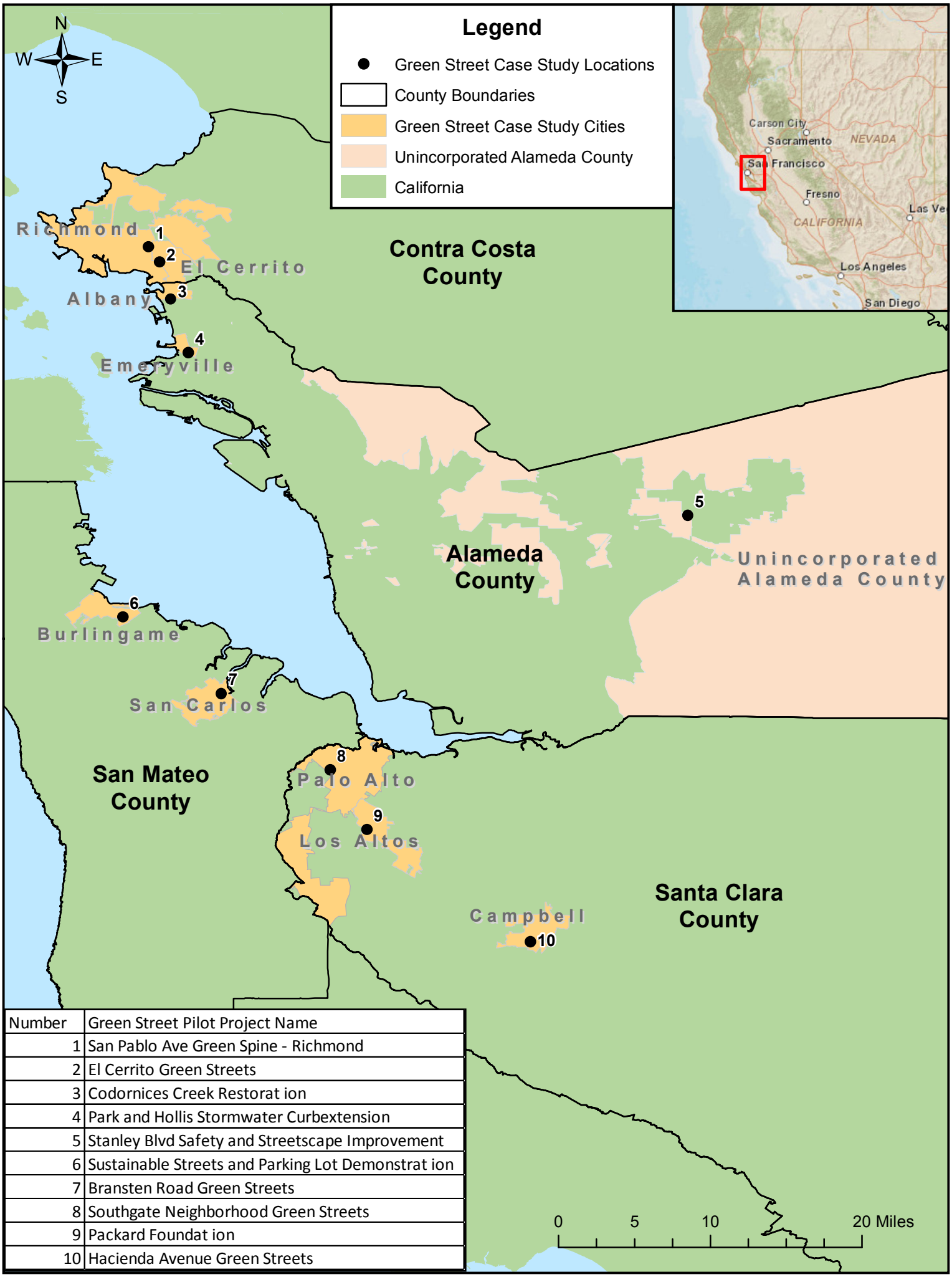
FIGURES



Number	Green Street Pilot Project Name
1	San Pablo Ave Green Spine - Richmond
2	El Cerrito Green Streets
3	Codornices Creek Restorat ion
4	Park and Hollis Stormwater Curbextension
5	Stanley Blvd Safety and Streetscape Improvement
6	Sustainable Streets and Parking Lot Demonstrat ion
7	Bransten Road Green Streets
8	Southgate Neighborhood Green Streets
9	Packard Foundat ion
10	Hacienda Avenue Green Streets

APPENDIX A

Green Street Pilot Projects Status Tables

Table A1. Project Information for 10 Selected Green Street Pilot Projects

Program	County	No.	Project Name	Owner/ Municipality	Project Location	Project Type (check all that apply)					Project Description	Project Attributes (check all that apply)									Project Status	Project Contact	Estimated Date of Comple-tion	Monitor-ing	Modeling	Project Status
						Arterial	Collector	Local	Parking Lot	Other (*specify*)		Bay-Friendly Landscaping	Stormwater Storage/Use	Stormwater Infiltration	Stormwater Treatment	Enhance Pedestrian and /or bicycle environment	Park-like elements	Connect residential, recreation, schools,	Parking Management	ABAG/MTC- designated Priority Development						
ACCWP	Alameda	1	Park and Hollis Stormwater Curb Extension	Emeryville	Northeast Corner of Park Ave and Hollis Street		X				Planted stormwater curbextension constructed in 2010 as part of new corner plaza area.	X	X			X	X			X	Constructed	Peter Schultze-Allen (Emeryville)	2010	None planned	Yes	Project completed. Pixar Animation Studios responsible, cost information not broken down or available.
		2	Codornices Creek Restoration Project	Berkeley, Albany, University of California	San Pablo Avenue at 6th Street			X			4 Rain Gardens/Bioretention areas with underdrains with discharge to Codornices Creek	X		X	X	X	X	X			Constructed	Jim Scanlin (ACPWA)	2011	Yes 5-Year Plan	Yes	Maintenance of all the improvements made on Codornices Creek is divided among the three agencies (Albany, Berkeley, and UC Berkeley) through a Memorandum of Understanding (MOU). The bioretention facilities were included in this MOU by an amendment before acceptance of construction.The Creek Project requires 5 years of monitoring.
		3	Stanley Boulevard Safety and Streetscape Improvement Project	Unincor-porated Alameda County	Stanley Boulevard Safety and Streetscape Improvement Project	X					Improving 3 miles of roadway, incorporating LID to convert industrial corridor to more rural parkway setting.	98		X	X	X	X	X			Contruction Phase	Justin Laurence (ACCWP)	September 2012	None planned	Yes	Construction is currently in progress. The BMPs have not yet begun construction.
CCCWP	Contra Costa	4	El Cerrito Green Streets	El Cerrito	10200 block of San Pablo Avenue (east side) and 11048 San Pablo Avenue	X					2 Rain Gardens (bioretention with underdrains)	X			X	X	X			X	Constructed	Stephen Pree (El Cerrito)	August 2010	Yes Conducted	Yes	The project was completed in August 2010 and completed water quality monitoring through WY 2012.
		5	San Pablo Avenue Greenspine Project	Richmond	12900 block of San Pablo Ave (west side) between McBryde Ave & Andrade Ave	X					5 Bioretention facilities, including infiltration			X		X	X	X			Preliminary Design Phase	Josh Brandt (SFEP)	Fall 2013	Planned	No	The project is currently in the 30% design phase. Design anticipated to be completed by late summer 2013 and construction to begin in late summer/fall 2013.
SMCWPPP	San Mateo	6	Sustainable Streets and Parking Lots Demonstration Project	Burlingame	1227 Donnelly Avenue, between Primose Road and Bellevue Avenue, Assessor Parcel Number 029-152-300			X	X		Rain Garden (bioretention without underdrain) and curb extention	X		X	X						Constructed	Jane Gomery (Burlingame)	January 2011	No	Yes	The project was completed in January 2011.
		7	Bransten Road Green Street	San Carlos	Bransten Road between Old County Road and Industrial Road			X			Bioretention areas in newly constructed curb extensions				X	X	X		X		100% Design Phase	Ray Chan (San Carlos)	December2014	CW4CB Task 5 Planned	Yes	The project is currently at the 100% design phase phase; construction is anticipated to be completed by the MRP Provision C.3.b.iii due date of December 1, 2014.
SCVURPPP	Santa Clara	8	Packard Foundation Project	Los Altos	343 Second Street, between Whitney and Lyell			X			Flow-through rain gardens in park strip along street and at an intersection; conversion of impervious to pervious area			X	X	X					Constructed	Jill Bicknell (SCVURPPP)	July 2012	None planned	Yes	Construction completed July 2012.
		9	Hacienda Avenue Green Street	Campbell	Hacienda Avenue, between South San Tomas Aquino Rd & Winchester Blvd	X					Improving 1 mile of roadway. Adding bike lanes, sidewalk infill, narrowing roadway width to install bioretention swales and bulbouts	X		X		X	X	X	X		Final Design Phase	Fred Ho (Campbell)	Late 2014/early 2015	Yes (water balance only)	Yes	Conceptual designs approved by City Council. Construction to begin in summer 2014.
		10	Southgate Neighborhood Green Street	Palo Alto	Various streets centered around Miramonte and Castilleja Avenues			X			Adding bioretention and biofiltration planters and pervious pavement throughout a residential neighborhood	X		X	X	X	X	X			Final Design Phase	Jill Bicknell (SCVURPPP)	Early 2014	None planned	Yes	Design received approval from city architectural review design staff. Construction to begin in fall 2013.

Table A2. Project Cost Information for 10 Selected Green Street Pilot Projects

Program	County	No.	Project Name	Owner/ Municipality	Project Location	Project Cost Estimate				Project Status	Project Contact	Funding (include Percentages)
						Construction Costs	Design Costs	Annual O&M Costs	Total Estimated Costs without Annual O&M			
ACCWP	Alameda	1	**Park and Hollis Stormwater Curbextension**	**Emeryville**	Northeast Corner of Park Ave and Hollis Street	Not Available	Not Available	Not Available	Not Available	Constructed	Peter Schultze-Allen (Emeryville)	Pixar Animation Studios
		2	**Codornices Creek Restoration Project**	**Berkeley, Albany, University of California**	San Pablo Avenue at 6th Street	$140,000	$35,000	$3,000	$175,000	Constructed	Jim Scanlin (ACPWA)	100% Funded by Prop 50 River Parkways Grant that was awarded to the City of Albany.
		3	**Stanley Boulevard Safety and Streetscape Improvement Project**	**Unincorporated Alameda County**	Stanley Boulevard Safety and Streetscape Improvement Project	Not Available	Not Available	Alameda County Public Works Maintenance & Operations Local Funds	$14,500,000	Contruction Phase	Justin Laurence (ACCWP)	State Prop 1B & Local funds (64.3%), CEMEX and Vulcan Materials Companies (34.5%), Bay Area Air Quality Management District – Transportation for Clean Air Grant Funds (0.008%), StopWaste.org Bay Friendly Grant Funds (0.002%)
CCCWP	Contra Costa	4	**El Cerrito Green Streets Project**	**El Cerrito**	10200 block of San Pablo Avenue (east side) and 11048 San Pablo Avenue	$324,127	Unknown	$5,000	$324,127	Constructed	Stephen Pree (El Cerrito)	This project was funded in large part through a federal ARRA grant through the State Water Resources Control Board ($392,000). This grant was split between the design/construction phase and the monitoring phase. The construction portion of that grant ($215,295) went to the City of El Cerrito as subgrantees. Other funding was from the El Cerrito Redevelopment Agency ($108,832).
		5	**San Pablo Avenue Greenspine Project**	**Richmond**	12900 block of San Pablo Ave (west side) between McBryde Ave & Andrade Ave	Not Available	Not Available	City of Richmond responsible	Not Available	Preliminary Design Phase	Josh Brandt (SFEP)	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
SMCWPPP	San Mateo	6	**Sustainable Streets and Parking Lots Demonstration Project**	**Burlingame**	1227 Donnelly Avenue, between Primose Road and Bellevue Avenue, Assessor Parcel Number 029-152-300	$215,000	$55,000	$65,000	$270,000	Constructed	Jane Gomery (Burlingame)	The San Mateo Countywide Water Pollution Prevention Program provided $250,000 of the funding. The City of Burlingame also contributed to the Capital Improvement Project from its General Fund.
		7	**Bransten Road Green Street**	**San Carlos**	Bransten Road between Old County Road and Industrial Road	$379,600	$156,000	Not Available	$535,600	100% Design Phase	Ray Chan (San Carlos)	EPA's San Francisco Bay Water Quality Improvement Fund (59%), San Mateo Countywide Water Pollution Prevention Program's Sustainable Creen Streets and Parking Lots Program (40%), Match from San Mateo Countywide Water Pollution Prevention Program (1%).
SCVURPPP	Santa Clara	8	**Packard Foundation Project**	Los Altos	343 Second Street, between Whitney and Lyell	Not Available - part of larger project	Not Available - part of larger project	Not Available	Not Available	Constructed	Jill Bicknell (SCVURPPP)	Funding was provided entirely by the David & Lucile Packard Foundation as part of construction of its headquarters office building. The Packard Foundation is responsible for operation and maintenance of the project.
		9	**Hacienda Avenue Green Street**	**Campbell**	Hacienda Avenue, between South San Tomas Aquino Rd & Winchester Blvd	Not Available	Not Available	Not Available	$4,635,000	Final Design Phase	Fred Ho (Campbell)	Received $2 million grant from State's IRWM program (43%) and $0.5 million in Federal funding via Caltrans (11%). City is providing the remainder of the funding (46%)."
		10	**Southgate Neighborhood Green Street**	**Palo Alto**	Various streets centered around Miramonte and Castilleja Avenues	$800,000 (estimate)	$300,000	Not Available	$1,100,000	Final Design Phase	Jill Bicknell (SCVURPPP)	The project is being funded entirely by the City of Palo Alto. The preliminary cost includes about 475 linear feet of new storm drain.

Table A3. Project Information for All Reported Bay Area Green Street Projects

Pro-gram	County	No.	Project Name	Owner/ Municipality	Project Location	Project Type (check all that apply)					Project Description	Project Attributes (check all that apply)									Project Status	Project Contact	Estimated Date of Comple-tion	WQ Monitor-ing	Modelling	Project Schedule, Funding, and Other Information
						Arterial	Collector	Local	Parking Lot	Other (*specify*)		Bay-Friendly Landscaping	Stormwater Storage/Use	Stormwater Infiltration	Stormwater Treatment	Enhance Pedestrian and /or bicycle environment	Park-like elements	Connect residential, recreation, schools,	Parking Management	ABAG/MTC- designated Priority Development						
ACCWP	Alameda	A1	**Park and Hollis Stormwater Curb Extension**	**Emeryville**	Northeast Corner of Park Ave and Hollis Street		X				Planted stormwater curbextension constructed in 2010 as part of new corner plaza area.	X	X			X	X			X	Constructed	Peter Schultze-Allen (Emeryville)	2010	None planned	Yes	Project completed. Pixar Animation Studios responsible, cost information not broken down or available.
		A2	**Codornices Creek Restoration Project**	**Berkeley, Albany, University of California**	San Pablo Avenue at 6th Street			X			4 Rain Gardens/Bioretention areas with underdrains with discharge to Codornices Creek	X		X	X	X	X	X			Constructed	Jim Scanlin (ACPWA)	2011	Yes 5-Year Plan	Yes	Maintenance is divided among 3 agencies (Albany, Berkeley, and UC Berkeley) through a Memorandum of Understanding (MOU) for entire project. The Creek Project requires 5 years of monitoring.
		A3	**Stanley Boulevard Safety and Streetscape Improvement Project**	**Unincor-porated Alameda County**	Stanley Boulevard Safety and Streetscape Improvement Project	X					Improving 3 miles of roadway, incorporating LID to convert industrial corridor to more rural parkway setting.	98		X	X	X	X	X			Contruction Phase	Justin Laurence (ACCWP)	September 2012	None planned	Yes	Construction is currently in progress. The BMPs have not yet begun construction. State Prop 1B & Local funds (64.3%), CEMEX and Vulcan Materials Companies (34.5%), Bay Area Air Quality Management District – Transportation for Clean Air Grant Funds (0.008%), StopWaste.org Bay Friendly Grant Funds (0.002%)
		A4	**San Pablo Avenue Greenspine Project**	**Albany**	San Pablo Ave & Monroe St, Albany 94706	X					3 Stormwater Curb Extensions and Sidewalk Planters	X			X		X				60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		A5	**San Pablo Avenue Greenspine Project**	**Berkeley**	San Pablo Ave & Cordornices Creek, Berkeley 94708	X					5 Stormwater Curb Extensions	X			X		X				60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		A6	**San Pablo Avenue Greenspine Project**	**Emeryville**	San Pablo Ave & W MacArthur Blvd, Emeryville 94608	X					3 Rain Gardens	X			X	X	X				60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		A7	**San Pablo Avenue Greenspine Project**	**Oakland**	San Pablo Ave & 17th Street, Oakland, 94612	X					Stormwater Planters and Street Trees	X		X	X		X		X		60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
CCCWP	Contra Costa	CC1	**El Cerrito Green Streets**	**El Cerrito**	10200 block of San Pablo Avenue (east side) and 11048 San Pablo Avenue	X					2 Rain Gardens (bioretention with underdrains)	X			X	X	X			X	Constructed	Stephen Pree (El Cerrito)	August 2010	Yes Conducted	Yes	Funded through a federal ARRA Grant and by the El Cerrito Redevelopment Agency and administered through the State Water Resources Control Board via SFEP.
		CC2	**San Pablo Avenue Greenspine Project**	**El Cerrito**	San Pablo Ave & Stockton Ave; San Pablo Ave & Moeser Ave, El Cerrito 94530; El Cerrito 94530	X					Stormwater Curb Extensions, Rain Gardens, and Sidewalk Planters	X		X	X		X				60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		CC3	**San Pablo Avenue Greenspine Project**	**Richmond**	12900 block of San Pablo Ave (west side) between McBryde Ave & Andrade Ave	X					5 Bioretention Facilities, including Infiltration	X		X		X	X	X			60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		CC4	**San Pablo Avenue Greenspine Project**	**San Pablo**	13613 San Pablo Ave, San Pablo 94806	X					Stormwater Planters	X					X				60% Design Phase	Josh Brandt (SFEP)	Fall 2014	Planned	No	Project is funded from USEPA SF Bay Water Quality Improvement Fund and the State's IRWM program. Construction funded by Caltrans. SFEP administers grants.
		CC5	**Nevine Avenue Improvements Green Streets**	**Richmond**	Nevin Avenue from 19th St to 27th St			X			Rain gardens (bioretention w/underdrain) curb extensions, permeable pavement			X	X	X	X				100% Design Phase	Lynn Scarpa (Richmond)	March 2014	Planned as part of CW4CB Task 5	No	The project is currently at the 100% design phase phase; construction is anticipated to be completed by the MRP Provision C.3.b.iii due date of December 1, 2014.

Table A3. Project Information for All Reported Bay Area Green Streets Projects

Pro-gram	County	No.	Project Name	Owner/ Municipality	Project Location	Project Type (check all that apply)					Project Description	Project Attributes (check all that apply)									Project Status	Project Contact	Estimated Date of Comple-tion	WQ Monitor-ing	Modelling	Project Status
						Arterial	Collector	Local	Parking Lot	Other (*specify*)		Bay-Friendly Landscaping	Stormwater Storage/Use	Stormwater Infiltration	Stormwater Treatment	Enhance Pedestrian and /or bicycle environment	Park-like elements	Connect residential, recreation, schools, streets,	Parking Management	ABAG/MTC- designated Priority Development Area					
		CC6	**PG&E Substation at 1st & Cutting**	**Richmond**	South 1st Street & Cutting Blvd, Richmond 94804		X				4 Bioretention areas (2 w/underdrains; 2 w/o underdrains)			X	X						100% Design Phase	Lynn Scarpa (Richmond)	October 2013	Planned as part of CW4CB Task 5	No	The project is currently at the 100% design phase phase; construction is anticipated to be completed by the MRP Provision C.3.b.iii due date of December 1, 2014.
SMCW PPP	**San Mateo**	**SM1**	**Sustainable Streets and Parking Lots Demonstration Project**	**Burlingame**	1227 Donnelly Avenue, between Primose Road and Bellevue Avenue, Assessor Parcel Number 029-152-300			X	X		Rain Garden (bioretention without underdrain) and curb extention	X		X	X						Constructed	Jane Gomery (Burlingame)	January 2011	No		Funding for the projects come from a countywide vehicle registration fee under Assembly Bill (AB) 1546, which went into effect on July 1, 2005, and was subsequently extended to 2012 through Senate Bill (SB) 348.
		SM2	**Bransten Road Green Street**	**San Carlos**	Bransten Road between Old County Road and Industrial Road			X			Bioretention areas in newly constructed curb extensions				X	X	X		X		100% Design Phase	Ray Chan (San Carlos)	December2014	Planned as part of CW4CB Task 5	Yes	The project is currently at the 100% design phase phase; construction is anticipated to be completed by the MRP Provision C.3.b.iii due date of December 1, 2014.
SCVUR PPP	**Santa Clara**	**SC1**	**Packard Foundation Project**	**Los Altos**	343 Second Street, between Whitney and Lyell			X			Flow-through rain gardens in park strip along street and at an intersection; conversion of impervious to pervious area			X	X	X					Constructed	Jill Bicknell (SCVURPPP)	July 2012	None planned	Yes	Construction completed July 2012. Funding was provided entirely by the David & Lucile Packard Foundation as part of construction of its headquarters office building.
		SC2	**Hacienda Avenue Green Street**	**Campbell**	Hacienda Avenue, between South San Tomas Aquino Rd & Winchester Blvd	X					Improving 1 mile of roadway. Adding bike lanes, sidewalk infill, narrowing roadway width to install bioretention swales and bulbouts	X		X		X	X	X	X		Final Design Phase	Fred Ho (Campbell)	Late 2014/early 2015	Yes (Water balance only)	Yes	Conceptual designs approved by City Council. Construction to begin in summer 2014. Funding assistance provided by $2 million grant from State's IRWM program (43%) and $0.5 million in Federal funding via Caltrans (11%). City is providing the remainder of the funding (46%).
		SC3	**Southgate Neighborhood Green Street**	**Palo Alto**	Various streets centered around Castilleja &Miramonte Aveunes			X			Adding bioretention and biofiltration planters and pervious pavement throughout a residential neighborhood	X		X	X	X	X	X			Final Design Phase	Jill Bicknell (SCVURPPP)	Early 2014	None planned	Yes	Design received approval from city architectural review design staff. Construction to begin in fall 2013. The project is being funded entirely by the City of Palo Alto.
		SC4	**Martha Gardens Green Alleys Pilot Project**	**San Jose**	Alley between Second and Third Street; Virginia and Martha Strret					x	"Green" concrete sloped to permeable pavers draining to below-grade infiltration galleries.			x	x	x					Project Design Phase	Jill Bicknell (SCVURPPP)	Late 2013	Pre and post-project sediment analysis	No	Project was selected for Prop 84 Stormwater Implementation Grant funding.
		SC5	**Park Avenue: Green Avenue Pilot Project**	**San Jose**	Park Avenue between Meridian Ave. and Sunol St.		x				Bioretention areas constructed at existing curb and at new curb extensions, and permeable paver median.			x	x	x					Preliminary Design Phase	Jill Bicknell (SCVURPPP)	Late 2014	Pre and post project pollutant analysis, flow reduction.	No	Project was selected for Prop 84 Stormwater Implementation Grant funding.

Table A4. Modeling Information for 10 Selected Green Street Pilot Projects

GREEN STREET PILOT PROJECTS										
	Park and Hollis Stormwater Curb Extension	**Codornices Creek Restoration**	**Stanley Boulevard Safety and Streetscape Improvement**	**El Cerrito Green Streets**	**San Pablo Avenue Green Spine - Richmond**	**Sustainable Green Streets and Parking Lots Demonstration**	**Bransten Road Green Streets**	**Southgate Neighborhood Green Streets Project**	**Packard Foundation Green Streets**	**Hacienda Avenue**
General Info										
County	Alameda	Alameda	Alameda	Contra Costa	Contra Costa	San Mateo	San Mateo	Santa Clara	Santa Clara	Santa Clara
City	Emeryville	Albany	Unincorporated Alameda County	El Cerrito	Richmond	Burlingame	San Carlos	Palo Alto	Los Altos	Campbell
Location	Northeast Corner of Park Ave and Hollis Street	San Pablo Avenue at 6th Street	3 mile stretch of Stanley Blvd between City Limits of Pleasanton and Livermore in Unincorporated Alameda County	Two Locations: 10200 block of San Pablo Avenue (east side) and 11048 San Pablo Avenue	12900 block of San Pablo Ave (west side) between McBryde Ave & Andrade Ave	1227 Donnelly Avenue, between Primose Road and Bellevue Avenue, Assessor Parcel Number 029-152-300	Bransten Road between Old County Road and Industrial Road	Various streets centered around Castilleja Avenue and Miramonte Avenue	Second Street from Lyell Street to Whitney Street	Hacienda Avenue between S. Winchester Boulevard and Burrows Road/San Tomas Aquino Road
Design Complete	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No. Expected completion September 2013.
Constructed	Yes	Yes	In Progress	Yes	No	Yes	No	No	Yes	No
Map/Plans	GIS	CADD (PDF)	CADD (PDF)	CADD (PDF)	CADD (PDF)	CADD (PDF)	CADD (PDF)	PDF	CADD (PDF)	Available
Drainage Area Size/Characteristics										
Drainage area (acre)	0.19 (8,470 sq-ft)	1.93	33	1.33	2.22	1.32	0.54	41.4	0.59	22.7
Ability to measure area	GIS	CADD (PDF)	CADD	CADD	GIS	CADD	CADD	AutoCAD	Building Plans	GIS
Pre-Construction % Imp	100	100	80	99	Not Known At This Time	95	95	67	100	74
Post-Construction % Imp	93	100	78	99	Not Known At This Time	90	95	66	89	71
Underlying Soil Type	Clay	Clay	Alluvium with silty sand (SM) with gravel and clayey sand (SC) with gravel	D	Not Known At This Time	Clayey Loam	Fill and Holocene-age alluvial fan deposits; HSG D	Lean clay with sand; clayey sand with gravel at 5-10 feet below grade	Sandy lean clay to clayey sand	Fine sandy silt, silty sand, gravelly sand
Infiltration Rate	Infeasible	Low impermeability	In-situ Percolation testing and site sampling PDF available	Low impermeability	Not Known At This Time	Yes, rate (0.1 in/hr, 0.17 in/hr)	Low impermeability	0.15-0.5 in/hr (at 5-10 feet below grade)	2 inches/hour	4 in/hr
Land Use	Commerical	Commercial, Residential, 60% in ROW	90% Public ROW, 10% Private	Commerical	Commercial	Commerical	Industrial	Residential	Commercial	Residential
LID Features										
BMP Type	Planted stormwater curb extension or on-street rain garden.	Rain garden/bioretention areas with underdrains	Linear treatment measure(bioswales on plans), infiltration trench (filter strips on plans)	Bioretention with underdrain	Bioretention with underdrain	Bioretention area and curb extension	Bioretention swales in curb extensions-Detailed plans available, some infiltrate	Bioretention and biofiltration planters, and pervious pavers	Curbside rain gardens and bulb-outs	Bioinfiltration
Number of BMPS	1	4	2	2	6	2	9	21	20	~80
Infiltration	Bioretention facilities lined with impermeable liner and has underdrains; No infiltration.	Bioretention facilities not lined; incidental infiltration from ponding beneath underdrain which drains to Creek.	Bioswale and filter strip not lined; Both have overflows and are connected to public storm drain; Incidental infiltration due to ponding.	Bioretention facilities not lined; incidental infiltration from ponding beneath underdrain	Not Known At This Time	Bioretention facilities not lined; No underdrain and not connected to public storm drains; designed to infiltrate onsite	Bioretention facilities not lined; incidental infiltration from ponding beneath underdrain and in bioretential facilities without underdrains	Bioretention facilities are not lined and most have no underdrains	Bioretention facilities are not lined and have no underdrains	Bioinfiltration units not lined, will not have underdrain but will have overflow outlet/drain
BMP Sizing	650 sq-ft	Facilities sized with surface areas of 180 sq-ft, 260 sq-ft, 224 sq-ft, and 425 sq-ft	Trench (13,895' long, 4' wide), LTM (13,895' long, 3' wide)	Madison Rain Gardens (7 individual gardens) sized to treat 0.38 ac w/tributary area 0.39 ac. Eureka Rain Gardens (12 individual gardens) sized to treat 0.64 ac w/tributary area 0.94 ac.	4,625 sq ft of proposed treatment area, primarily through central rain garden and 5 curb extension planters.	0.06 acre bioretention (rain garden-infiltrates), 0.01 acre planter box (curb extension)	0.10 acres (from WRECO Memo, Feb 2013)	Bioretention with underdrains = 906 sq. ft.; bioretention without underdrains = 2,618 sq. ft.; pervious pavers = 8,712 sq. ft.	1834 sq. ft. (0.042 acres) total surface area	~26,000 sq. ft. (0.6 acres) total surface area
Stormwater Design Criteria	Volume Hydraulic Design Basis, 4% of catchment area method	Alameda County Sizing Criteria	Volume Hydraulic Design Basis. Stormwater Quality Handbook recommends a bioswale area that is 4% the size of the impervious area. 4% will adequately be able to capture and treat 0.2 in/hr of rainfall. The storm drain pipes are sized to handle a 2.0 in/hr storm.	Volume Hydraulic Design Basis	At this stage of planning, still using Contra Costa Countywide Clean Water Program c.3 sizing criteria of 4% of tributary area.	Flow Hydraulic Design Basis, 0.2" per hour of rainfall intensity	Volume Hydraulic Design Basis, 4% of catchment area method	Volume-based (85th percentile storm event)	Volume basis; actual size based on space available	Not Known At This Time
Design Specifications/Resources	Countywide Program C3 Design Manual	C3 Guidelines used as basis	Alameda County Design Guidelines, (State) Caltrans Standard Plans and Specifications, AASHTO and the Roadside Design Guide Policies, Cities of Livermore and Pleasanton design standards/requirements, Bay Friendly Guidelines, Various Utilities (PG&E, AT&T, Comcast), Railroad (UPRR), and (EBRPD) Park District requirements, and C3 Stormwater Technical Guidance.	C3 Guidelines	Not Known At This Time	San Mateo Countywide Program, C3 Stormwater Technical Guidance	San Mateo Countywide Program, C3 Stormwater Technical Guidance	Santa Clara County Drainage Manual and Los Angeles County Hydrology Manual	SCVURPPP C.3 Stormwater Handbook	SCVURPPP C.3 Stormwater Handbook

Table A4. Modeling Information for 10 Selected Green Street Pilot Projects

GREEN STREET PILOT PROJECTS										
	Park and Hollis Stormwater Curb Extension	**Codornices Creek Restoration**	**Stanley Boulevard Safety and Streetscape Improvement**	**El Cerrito Green Streets**	**San Pablo Avenue Green Spine - Richmond**	**Sustainable Green Streets and Parking Lots Demonstration**	**Bransten Road Green Streets**	**Southgate Neighborhood Green Streets Project**	**Packard Foundation Green Streets**	**Hacienda Avenue**
Water Quality Data										
Pre-Construction WQ Data	None Available	None Available	None Available	None Available	Not Known At This Time	None Available	None Available	None Available	None Available	None Available
Mean Annual Precip	Pull from rainfall record	20	Pull from rainfall record	Pull from rainfall record	Pull from rainfall record	18.77 inches of rainfall.	Pull from rainfall record	18 inches	18 inches	19 inches
WQ Monitoring	None planned	None planned	None planned	Conducted 2011-2012	Planned (SFEI)	None planned	CW4CB Task 5 planned	Not Known At This Time	None planned	None planned

Geosyntec consultants

APPENDIX B

Spreadsheet Model Results

Table B1. Modeling Results for Green Street Pilot Projects with 25% Incidental Infiltration

Project Name	Average Annual Runoff (cu-ft)	Total Effluent Volume[1] (cu-ft)	Average Annual Influent Loads					Average Annual Load Reduction				
			TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)	TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)
Bransten Road Green Street Project	24134	19911	77679	24944	216295	103	39	48025	4365	37852	66	24
Codornices Creek Restoration Project	113904	93971	366620	117727	1020838	488	184	226662	20602	178647	312	115
El Cerrito Green Streets Project	78935	65122	254068	81585	707441	338	128	157077	14277	123802	216	80
Packard Foundation Project	24703	20380	64355	22559	204609	5	16	38549	3948	35806	3	15
Park and Hollis Stormwater Curbextension	10593	8739	34096	10949	94938	45	17	21080	1916	16614	29	11
Stanley Blvd Safety and Streetscape Improvement Project	771549	636528	2009999	704592	6390485	152	794	1203978	123304	1118335	91	476
Sustainable Streets and Parking Lots Demonstration Project	60547	49951	157733	55292	501488	12	62	94481	9676	87760	7	37
San Pablo Avenue Green Spine Project (City of Richmond segment)	71813	59246	187084	65581	594807	14	74	112063	11477	104091	8	44
Hacienda Avenue Green Streets	758221	625532	1975276	692420	6280090	149	780	1183180	121174	1099016	89	467
Southgate Neighborhood Green Streets Project	1285452	1060498	3348790	11738790	10646968	253	1323	2005907	205432	1863219	151	792

Notes:
[1] Total Effluent Volume refers to the sum of the effluent volume from the BMPs and the bypassed volume.

Table B2. Modeling Results for Green Streets Pilot Projects with 50% Incidental Infiltration

Project Name	Average Annual Runoff (cu-ft)	Total Effluent Volume[1] (cu-ft)	Average Annual Influent Loads					Average Annual Load Reduction				
			TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)	TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)
Bransten Road Green Street Project	24134	15687	77679	24944	216295	103	39	50142	8730	75703	68	25
Codornices Creek Restoration Project	113904	74038	366620	117727	1020838	488	184	236653	41204	357293	322	120
El Cerrito Green Streets Project	78935	51308	254068	81585	707441	338	128	164000	28555	247604	223	83
Packard Foundation Project	24703	16057	64355	22559	204609	5	25	40715	7896	71613	3	16
Park and Hollis Stormwater Curbextension	10593	6885	34096	10949	94938	45	17	22009	3832	33228	30	11
Stanley Blvd Safety and Streetscape Improvement Project	771549	501507	2009999	704592	6390485	152	794	1271652	246607	2236670	96	502
Sustainable Streets and Parking Lots Demonstration Project	60547	39355	157733	55292	501488	12	62	99792	19352	175521	8	39
San Pablo Avenue Green Spine Project (City of Richmond segment)	71813	46679	187084	65581	594807	14	74	118361	22953	208182	9	47
Hacienda Avenue Green Streets	758221	492844	1975276	692420	6280090	149	780	1249684	242347	2198032	94	494
Southgate Neighborhood Green Streets Project	1285452	835544	3348790	1173896	10646968	253	1323	2118656	410864	3726439	160	837

Notes:
[1] Total Effluent Volume refers to the sum of the effluent volume from the BMPs and the bypassed volume.

Table B3. Modeling Results for Green Streets Pilot Projects with 75% Incidental Infiltration

Project Name	Average Annual Runoff (cu-ft)	Total Effluent Volume[1] (cu-ft)	Average Annual Influent Loads					Average Annual Load Reduction				
			TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)	TSS (g)	Cu (mg)	Zn (mg)	PCBs (mg)	HgT (mg)
Bransten Road Green Street Project	24134	11464	77679	24944	216295	103	39	52259	13096	113555	70	26
Codornices Creek Restoration Project	113904	54104	366620	117727	1020838	488	184	246643	61807	535940	331	124
El Cerrito Green Streets Project	78935	37494	254068	81585	707441	338	128	170924	42832	371406	230	86
Packard Foundation Project	24703	11734	64355	22559	204609	5	25	42882	11844	107419	3	17
Park and Hollis Stormwater Curbextension	10593	5032	34096	10949	94938	45	17	22938	5748	49842	31	12
Stanley Blvd Safety and Streetscape Improvement Project	771549	366486	2009999	704592	6390485	152	794	1339325	369911	3355004	101	529
Sustainable Streets and Parking Lots Demonstration Project	60547	28760	157733	55292	501488	12	62	105102	29028	263281	8	42
San Pablo Avenue Green Spine Project (City of Richmond segment)	71813	34111	187084	65581	594807	14	74	124660	34430	312273	9	49
Hacienda Avenue Green Streets	758221	360155	1975276	692420	6280090	149	780	1316189	363521	3297047	99	520
Southgate Neighborhood Green Streets Project	1285452	610590	3348790	1173896	10646968	253	1323	2231404	616296	5589658	168	881

Notes:

[1] Total Effluent Volume refers to the sum of the effluent volume from the BMPs and the bypassed volume.

Geosyntec consultants

APPENDIX C

Green Street Pilot Projects Design Plans

NOTE: FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

INDEX OF SHEETS:

Sheet No.	Description	
1	Title Sheet	
2–5	Demolition Plan	DM–1/4
6–9	Layout	L–1/4
10–13	Grading Plan	GR–1/4
14–17	Utility & Storm Drain Plan	U–1/4
18–19	Construction Details	C–1/2
20	Notes and Legend	HP1.1
21	Planting Notes and Legend	HP1.2
22–25	Landscape Layout Plan	HP2.1/2.4
26–29	Planting Plan	HP3.1/3.4
30–33	Irrigation Plan	HP4.1/4.4
34	Irrigation Notes and Legend	HP4.5
35–37	Irrigation Details	HP4.6/4.8
38–39	Landscape Details	HP5.1/5.2

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN CONTRA COSTA COUNTY
IN EL CERRITO
AT SAN PABLO AVENUE (SR 123)

To be supplemented by Standard Plans dated May 2006

San Pablo Avenue Rain Garden Project

DST	COUNTY	ROUTE	MILES POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	123	0.0/2.1	1	39

Caltrans

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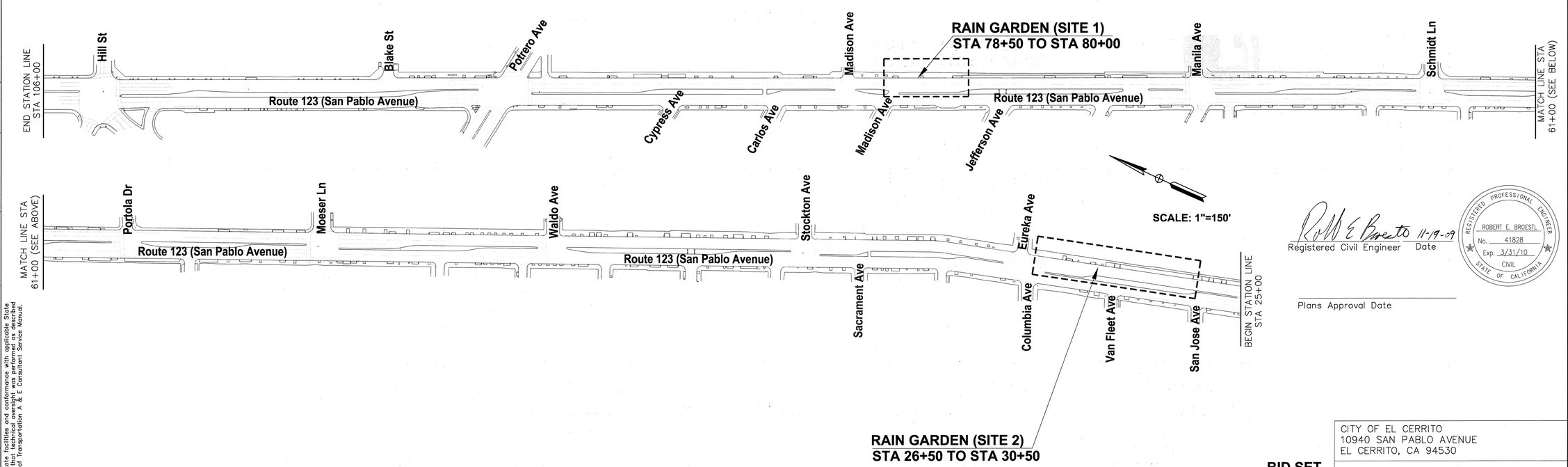


Registered Civil Engineer — Date 11-19-09

REGISTERED PROFESSIONAL ENGINEER — ROBERT E. BROESTL — No. 41828 — Exp. 3/31/10 — CIVIL — STATE OF CALIFORNIA

Plans Approval Date

BID SET

November 19, 2009

CITY OF EL CERRITO
10940 SAN PABLO AVENUE
EL CERRITO, CA 94530

GATES AND ASSOCIATES
2671 CROW CANYON ROAD
SAN RAMON, CA 94583

BELLECCI & ASSOCIATES, INC.
2290 DIAMOND BOULEVARD, SUITE #100
CONCORD, CA 94520

City Contract No. C4016

LAST REVISION 00-00-00
DATE PLOTED=>
TIME PLOTED=>

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER	CALTRANS DESIGN OVERSIGHT APPROVAL	REGISTRATION NO.	LICENSE EXP. DATE	DATE SIGNED

Approved as to impact on State facilities and conformance with applicable State standards and practices and that technical oversight was performed as described in the California Department of Transportation A & E Consultant Service Manual.

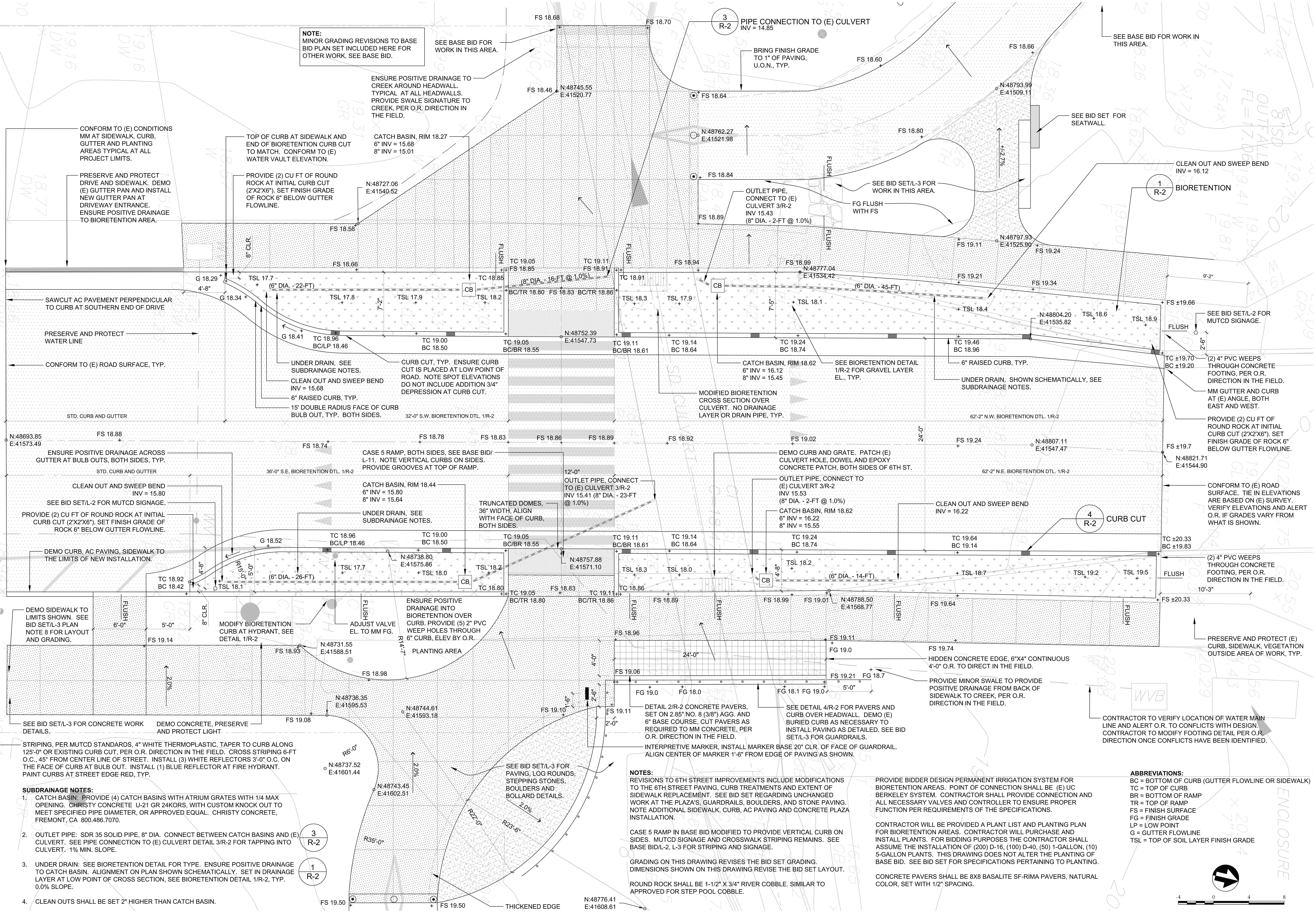
The Contractor shall possess the Class (or Classes) of license as specified in the "Notice to Contractors".

FOR REDUCED PLANS ORIGINAL SCALE IN INCHES 0 100 200 300 400 500

CITY CONTRACT NO.: C4016
DGN FILE=> DG TITLE_PHASE 2

CU 04275

EA 4A5604


NOTE:
MINOR GRADING REVISIONS TO BASE BID PLAN SET INCLUDED HERE FOR OTHER WORK, SEE BASE BID.
SEE BASE BID FOR WORK IN THIS AREA.
3 R-2 PIPE CONNECTION TO (E) CULVERT INV = 14.85
BRING FINISH GRADE TO 1" OF PAVING, U.O.N., TYP.
SEE BASE BID FOR WORK IN THIS AREA.
ENSURE POSITIVE DRAINAGE TO CREEK AROUND HEADWALL. TYPICAL AT ALL HEADWALLS. PROVIDE SWALE SIGNATURE TO CREEK, PER O.R. DIRECTION IN THE FIELD.
SEE BID SET FOR SEATWALL.
CONFORM TO (E) CONDITIONS MM AT SIDEWALK, CURB, GUTTER AND PLANTING AREAS TYPICAL AT ALL PROJECT LIMITS.
TOP OF CURB AT SIDEWALK AND END OF BIORETENTION CURB CUT TO MATCH. CONFORM TO (E) WATER VAULT ELEVATION.
CATCH BASIN, RIM 18.27 6" INV = 15.68 8" INV = 15.01
PRESERVE AND PROTECT DRIVE AND SIDEWALK. DEMO (E) GUTTER PAN AND INSTALL NEW GUTTER PAN AT DRIVEWAY ENTRANCE. ENSURE POSITIVE DRAINAGE TO BIORETENTION AREA.
PROVIDE (2) CU FT OF ROUND ROCK AT INITIAL CURB CUT (2'X2'X6"). SET FINISH GRADE OF ROCK 6" BELOW GUTTER FLOWLINE.
CLEAN OUT AND SWEEP BEND INV = 16.12
1 R-2 BIORETENTION
SEE BID SET/L-3 FOR WORK IN THIS AREA.
OUTLET PIPE, CONNECT TO (E) CULVERT 3/R-2 INV 15.43 (8" DIA. - 2-FT @ 1.0%)
FG FLUSH WITH FS
SAWCUT AC PAVEMENT PERPENDICULAR TO CURB AT SOUTHERN END OF DRIVE
SEE BID SET/L-2 FOR MUTCD SIGNAGE.
PRESERVE AND PROTECT WATER LINE
CONFORM TO (E) ROAD SURFACE, TYP.
UNDER DRAIN, SEE SUBDRAINAGE NOTES.
CLEAN OUT AND SWEEP BEND INV = 15.68
6" RAISED CURB, TYP.
15' DOUBLE RADIUS FACE OF CURB BULB OUT, TYP. BOTH SIDES.
CURB CUT, TYP. ENSURE CURB CUT IS PLACED AT LOW POINT OF ROAD. NOTE SPOT ELEVATIONS DO NOT INCLUDE ADDITION 3/4" DEPRESSION AT CURB CUT.
CATCH BASIN, RIM 18.62 6" INV = 16.12 8" INV = 15.45
SEE BIORETENTION DETAIL 1/R-2 FOR GRAVEL LAYER EL., TYP.
6" RAISED CURB, TYP.
UNDER DRAIN, SHOWN SCHEMATICALLY, SEE SUBDRAINAGE NOTES.
(2) 4" PVC WEEPS THROUGH CONCRETE FOOTING, PER O.R. DIRECTION IN THE FIELD.
MM GUTTER AND CURB AT (E) ANGLE, BOTH EAST AND WEST.
MODIFIED BIORETENTION CROSS SECTION OVER CULVERT. NO DRAINAGE LAYER OR DRAIN PIPE, TYP.
PROVIDE (2) CU FT OF ROUND ROCK AT INITIAL CURB CUT (2'X2'X6"). SET FINISH GRADE OF ROCK 6" BELOW GUTTER FLOWLINE.
STD. CURB AND GUTTER
32'-0" S.W. BIORETENTION DTL. 1/R-2
62'-2" N.W. BIORETENTION DTL. 1/R-2
ENSURE POSITIVE DRAINAGE ACROSS GUTTER AT BULB OUTS, BOTH SIDES, TYP.
CASE 5 RAMP, BOTH SIDES, SEE BASE BID/ L-11. NOTE VERTICAL CURBS ON SIDES. PROVIDE GROOVES AT TOP OF RAMP.
DEMO CURB AND GRATE. PATCH (E) CULVERT HOLE, DOWEL AND EPOXY CONCRETE PATCH, BOTH SIDES OF 6TH ST.
36'-0" S.E. BIORETENTION DTL. 1/R-2
62'-2" N.E. BIORETENTION DTL. 1/R-2
OUTLET PIPE, CONNECT TO (E) CULVERT 3/R-2 INV 15.41 (8" DIA. - 23-FT @ 1.0%)
OUTLET PIPE, CONNECT TO (E) CULVERT 3/R-2 INV 15.53 (8" DIA. - 2-FT @ 1.0%)
CONFORM TO (E) ROAD SURFACE. TIE IN ELEVATIONS ARE BASED ON (E) SURVEY. VERIFY ELEVATIONS AND ALERT O.R. IF GRADES VARY FROM WHAT IS SHOWN.
CLEAN OUT AND SWEEP BEND INV = 15.80
CATCH BASIN, RIM 18.44 6" INV = 15.80 8" INV = 15.64
SEE BID SET/L-2 FOR MUTCD SIGNAGE.
CATCH BASIN, RIM 18.62 6" INV = 16.22 8" INV = 15.55
CLEAN OUT AND SWEEP BEND INV = 16.22
TRUNCATED DOMES, 36" WIDTH, ALIGN WITH FACE OF CURB, BOTH SIDES.
4 R-2 CURB CUT
PROVIDE (2) CU FT OF ROUND ROCK AT INITIAL CURB CUT (2'X2'X6"). SET FINISH GRADE OF ROCK 6" BELOW GUTTER FLOWLINE.
UNDER DRAIN, SEE SUBDRAINAGE NOTES.
DEMO CURB, AC PAVING, SIDEWALK TO THE LIMITS OF NEW INSTALLATION.
(2) 4" PVC WEEPS THROUGH CONCRETE FOOTING, PER O.R. DIRECTION IN THE FIELD.
ENSURE POSITIVE DRAINAGE INTO BIORETENTION OVER CURB. PROVIDE (5) 2" PVC WEEP HOLES THROUGH 6" CURB, ELEV BY O.R.
DEMO SIDEWALK TO LIMITS SHOWN. SEE BID SET/L-3 PLAN NOTE 8 FOR LAYOUT AND GRADING.
MODIFY BIORETENTION CURB AT HYDRANT, SEE DETAIL 1/R-2
ADJUST VALVE EL. TO MM FG.
PLANTING AREA
PRESERVE AND PROTECT (E) CURB, SIDEWALK, VEGETATION OUTSIDE AREA OF WORK, TYP.
HIDDEN CONCRETE EDGE, 6"X4" CONTINUOUS 4'-0" O.R. TO DIRECT IN THE FIELD.
PROVIDE MINOR SWALE TO PROVIDE POSITIVE DRAINAGE FROM BACK OF SIDEWALK TO CREEK, PER O.R. DIRECTION IN THE FIELD.
SEE BID SET/L-3 FOR CONCRETE WORK DETAILS.
DEMO CONCRETE, PRESERVE AND PROTECT LIGHT
DETAIL 2/R-2 CONCRETE PAVERS, SET ON 2.85" NO. 8 (3/8") AGG. AND 6" BASE COURSE, CUT PAVERS AS REQUIRED TO MM CONCRETE, PER O.R. DIRECTION IN THE FIELD.
SEE DETAIL 4/R-2 FOR PAVERS AND CURB OVER HEADWALL. DEMO (E) BURIED CURB AS NECESSARY TO INSTALL PAVING AS DETAILED. SEE BID SET/L-3 FOR GUARDRAILS.
CONTRACTOR TO VERIFY LOCATION OF WATER MAIN LINE AND ALERT O.R. TO CONFLICTS WITH DESIGN. CONTRACTOR TO MODIFY FOOTING DETAIL PER O.R. DIRECTION ONCE CONFLICTS HAVE BEEN IDENTIFIED.
INTERPRETIVE MARKER, INSTALL MARKER BASE 20" CLR. OF FACE OF GUARDRAIL. ALIGN CENTER OF MARKER 1'-6" FROM EDGE OF PAVING AS SHOWN.
STRIPING, PER MUTCD STANDARDS, 4" WHITE THERMOPLASTIC. TAPER TO CURB ALONG 125'-0" OR EXISTING CURB CUT, PER O.R. DIRECTION IN THE FIELD. CROSS STRIPING 6-FT O.C., 45° FROM CENTER LINE OF STREET. INSTALL (3) WHITE REFLECTORS 3'-0" O.C. ON THE FACE OF CURB AT BULB OUT. INSTALL (1) BLUE REFLECTOR AT FIRE HYDRANT. PAINT CURBS AT STREET EDGE RED, TYP.
SEE BID SET/L-3 FOR PAVING, LOG ROUNDS, STEPPING STONES, BOULDERS AND BOLLARD DETAILS.
THICKENED EDGE

SUBDRAINAGE NOTES:

1. CATCH BASIN: PROVIDE (4) CATCH BASINS WITH ATRIUM GRATES WITH 1/4 MAX OPENING. CHRISTY CONCRETE U-21 GR 24KORS, WITH CUSTOM KNOCK OUT TO MEET SPECIFIED PIPE DIAMETER, OR APPROVED EQUAL. CHRISTY CONCRETE, FREMONT, CA 800.486.7070.
2. OUTLET PIPE: SDR 35 SOLID PIPE, 8" DIA. CONNECT BETWEEN CATCH BASINS AND (E) CULVERT. SEE PIPE CONNECTION TO (E) CULVERT DETAIL 3/R-2 FOR TAPPING INTO CULVERT. 1% MIN. SLOPE. (3 / R-2)
3. UNDER DRAIN: SEE BIORETENTION DETAIL FOR TYPE. ENSURE POSITIVE DRAINAGE TO CATCH BASIN. ALIGNMENT ON PLAN SHOWN SCHEMATICALLY. SET IN DRAINAGE LAYER AT LOW POINT OF CROSS SECTION, SEE BIORETENTION DETAIL 1/R-2, TYP. 0.0% SLOPE. (1 / R-2)
4. CLEAN OUTS SHALL BE SET 2" HIGHER THAN CATCH BASIN.

NOTES:

REVISIONS TO 6TH STREET IMPROVEMENTS INCLUDE MODIFICATIONS TO THE 6TH STREET PAVING, CURB TREATMENTS AND EXTENT OF SIDEWALK REPLACEMENT. SEE BID SET REGARDING UNCHANGED WORK AT THE PLAZA'S, GUARDRAILS, BOULDERS, AND STONE PAVING. NOTE ADDITIONAL SIDEWALK, CURB, AC PAVING AND CONCRETE PLAZA INSTALLATION.

CASE 5 RAMP IN BASE BID MODIFIED TO PROVIDE VERTICAL CURB ON SIDES. MUTCD SIGNAGE AND CROSSWALK STRIPING REMAINS. SEE BASE BID/L-2, L-3 FOR STRIPING AND SIGNAGE.

GRADING ON THIS DRAWING REVISES THE BID SET GRADING. DIMENSIONS SHOWN ON THIS DRAWING REVISE THE BID SET LAYOUT.

ROUND ROCK SHALL BE 1-1/2" X 3/4" RIVER COBBLE. SIMILAR TO APPROVED FOR STEP POOL COBBLE.

PROVIDE BIDDER DESIGN PERMANENT IRRIGATION SYSTEM FOR BIORETENTION AREAS. POINT OF CONNECTION SHALL BE (E) UC BERKELEY SYSTEM. CONTRACTOR SHALL PROVIDE CONNECTION AND ALL NECESSARY VALVES AND CONTROLLER TO ENSURE PROPER FUNCTION PER REQUIREMENTS OF THE SPECIFICATIONS.

CONTRACTOR WILL BE PROVIDED A PLANT LIST AND PLANTING PLAN FOR BIORETENTION AREAS. CONTRACTOR WILL PURCHASE AND INSTALL PLANTS. FOR BIDDING PURPOSES THE CONTRACTOR SHALL ASSUME THE INSTALLATION OF (200) D-16, (100) D-40, (50) 1-GALLON, (10) 5-GALLON PLANTS. THIS DRAWING DOES NOT ALTER THE PLANTING OF BASE BID. SEE BID SET FOR SPECIFICATIONS PERTAINING TO PLANTING.

CONCRETE PAVERS SHALL BE 8X8 BASALITE SF-RIMA PAVERS, NATURAL COLOR, SET WITH 1/2" SPACING.

ABBREVIATIONS:

BC = BOTTOM OF CURB (GUTTER FLOWLINE OR SIDEWALK)
TC = TOP OF CURB
BR = BOTTOM OF RAMP
TR = TOP OF RAMP
FS = FINISH SURFACE
FG = FINISH GRADE
LP = LOW POINT
G = GUTTER FLOWLINE
TSL = TOP OF SOIL LAYER FINISH GRADE

DATE	NO.	REVISIONS
10.22.10	1	CONCRETE PAVERS / DIMENSIONING
11.24.10	2	REMOVED SPEED TABLE / GRADING / BULB OUT
11.30.10	3	RESOLVE WATER LINE / DRAIN PIPE CONFLICTS

Restoration Design Group, LLC
2612b Eighth Street
Berkeley, CA 94710
T 510.644.2798 F 510.644.2799
www.restorationdesigngroup.com

LOWER CODORNICES CREEK - PHASE III
CREEK RESTORATION & SITE IMPROVEMENTS PLAN

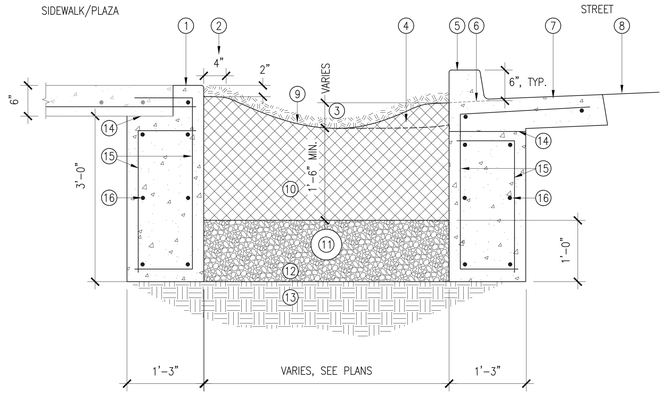
CITY OF ALBANY / CITY OF BERKELEY / UNIVERSITY OF CALIFORNIA BERKELEY

CONSTRUCTION SET

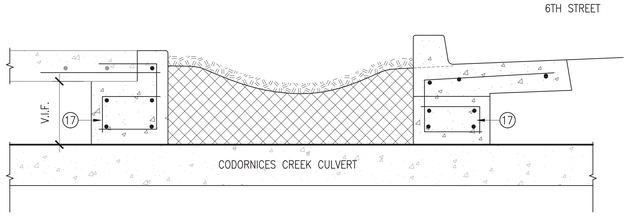
NOVEMBER 30, 2010

REVISED 6TH STREET PLAN

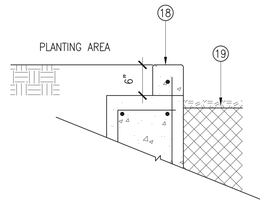
SHEET R-1



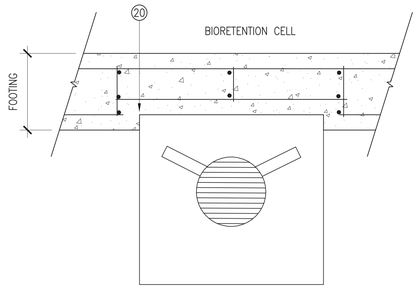
TYPICAL CONDITION



AT CODORNICES CREEK CULVERT



BIORETENTION CONCRETE CURB AND FOOTING WHEN ADJACENT TO PLANTING AREAS



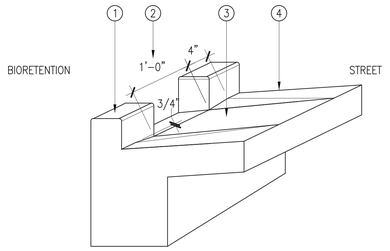
BIORETENTION CURB AND FOOTING MODIFICATIONS AT FIRE HYDRANT: PLAN VIEW

1. SIDEWALK/PLAZA SEE BASE BID AND REVISED 6TH STREET PLAN. SEE R-1 FOR ELEVATIONS. NO THICKENED EDGE AT BIORETENTION. POUR 6" CURB MONOLITHIC WITH FOOTING.
2. MOUND TOP OF SOIL (TSL) TO WITHIN 2" OF SIDEWALK/PLAZA PER O.R. DIRECTION IN THE FIELD. HOLD BOTH SIDES LEVEL 4" AT EQUAL ELEVATION.
3. TSL AT BIORETENTION LOW POINT. ELEVATIONS NOTED ON PLANS INDICATE BIORETENTION LOW POINT.
4. INLET DEPRESSION, DEPRESS FINISH GRADE OF SOIL AT CURB CUTS 4"–6" BELOW GUTTER FLOWLINE, PER O.R. DIRECTION. SEE NOTES ON PLAN FOR (3) LOCATIONS TO RECEIVE COBBLE AT INLET DEPRESSION.
5. CONCRETE CURB, SEE BERKELEY STD. DETAILS. ENSURE POSITIVE DRAINAGE OVER CURB. SEE R-1 FOR ELEVATIONS.
6. CURB CUT, SEE DETAIL 2/R-2.
7. GUTTER PAN, SEE BERKELEY STANDARD DETAIL.
8. AC PAVING, SEE BASE BID.
9. MULCH, 2" DEPTH ABOVE TSL. SEE BID SET SPECS.
10. SOIL LAYER, SEE CONTRA COSTA CLEAN WATER PROGRAM STORMWATER C.3 GUIDEBOOK APPENDIX B FOR SPEC.
11. UNDER DRAIN, 6" DIA. PVC SDR 35 OR EQUIVALENT, PERFORATED WITH HOLES FACING DOWN. BED NEAR TOP OF GRAVEL LAYER. SEE PLANS FOR EXTENT. PROVIDE SWEEP BEND AND CLEANOUT AT END. CLEANOUT ELEVATION 2" ABOVE OVERFLOW ELEV.
12. DRAINAGE LAYER, CLASS II PERMEABLE. OMIT WHERE DIRECTLY ABOVE 6TH STREET CULVERT.
13. SUBGRADE
14. COLD JOINT, CLEAN AND ROUGH
15. #4 REBAR @12" O.C. HOOK TOP AND BOTTOM AS SHOWN, 3" CLR TYP.
16. CONCRETE FOOTING WITH (6) #4 REBAR AS SHOWN.
17. TRUNCATE BOTTOM OF CONCRETE FOOTING AT CULVERT. MODIFY REBAR AS REQUIRED TO ENSURE 3" CLR. VERIFY IN FIELD BY O.R.
18. CURB, 6" WIDTH, INSTALL (1) #4 REBAR CONTINOUS.
19. HOLD TSL LEVEL TO BIORETENTION CURB AT THE S.E. BIORETENTION AREA ONLY, WHEN ADJACENT TO PLANTING AREA, AS SHOWN,
20. MODIFY CONCRET FOOTING THICKNESS TO ACCOMMODATE FIRE HYDRANT. MODIFY REBAR TO ENSURE 3" CLR AS SHOWN.

NOTE:
- CONTINUE TRUNCATED FOOTING AND SOIL PROFILE ON SOUTHERN SIDE OF CULVERT @ THE NW BIORETENTION CELL.

1 BIORETENTION

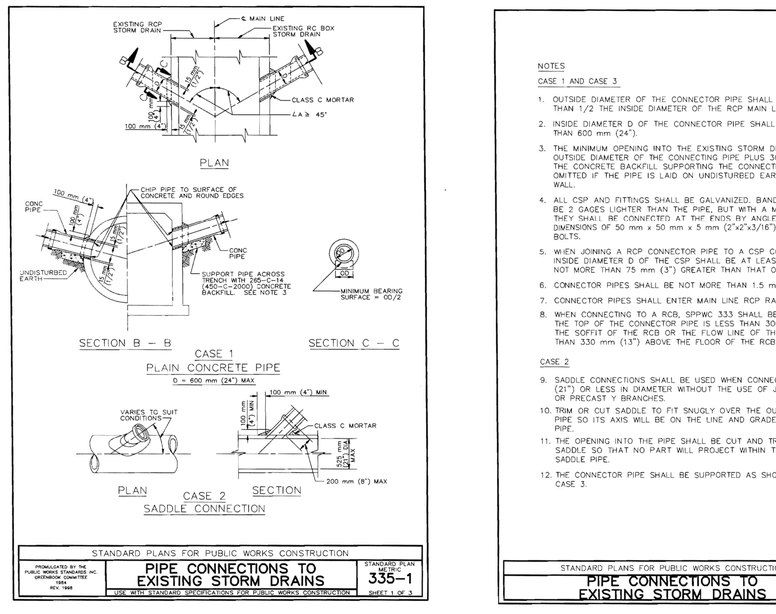
SCALE: NTS



1. CURB, SEE PLANS AND BIORETENTION DETAIL 1/R-1.
2. CURB CUT, 1'-0" WIDE, CONTINUE GUTTER PAN SLOPE DOWN CURB CUT INTO BIORETENTION AREA. ENSURE POSITIVE DRAINAGE INTO BIORETENTION AREA
3. CURB CUT DEPRESSION. DEPRESS GUTTER PAN 3/4" ACROSS 4" ON BOTH SIDES OF CURB CUT AS SHOWN.
4. GUTTER PAN, SEE BERKELEY STD. DETAILS.

2 CURB CUT

SCALE: NTS



STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PROMULGATED BY THE PUBLIC WORKS STANDARDS INC. GREENBOOK COMMITTEE 1994 R/V 1998

PIPE CONNECTIONS TO EXISTING STORM DRAINS

USE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

STANDARD PLAN METRIC 335–1 SHEET 1 OF 3

NOTES

CASE 1 AND CASE 3

1. OUTSIDE DIAMETER OF THE CONNECTOR PIPE SHALL NOT BE GREATER THAN 1/2 THE INSIDE DIAMETER OF THE RCP MAIN LINE.
2. INSIDE DIAMETER D OF THE CONNECTOR PIPE SHALL NOT BE GREATER THAN 600 mm (24").
3. THE MINIMUM OPENING INTO THE EXISTING STORM DRAIN SHALL BE THE OUTSIDE DIAMETER OF THE CONNECTING PIPE PLUS 30 mm (1"). THE CONCRETE BACKFILL SUPPORTING THE CONNECTING PIPE MAY BE OMITTED IF THE PIPE IS LAID ON UNDISTURBED EARTH TO STORM DRAIN WALL.
4. ALL CSP AND FITTINGS SHALL BE GALVANIZED. BAND CONNECTORS MAY BE 2 GAGES LIGHTER THAN THE PIPE, BUT WITH A MINIMUM GAGE OF 16. THEY SHALL BE CONNECTED AT THE ENDS BY ANGLES HAVING MINIMUM DIMENSIONS OF 50 mm x 50 mm x 5 mm (2"x2"x3/16") AND 140 mm (5 1/2") BOLTS.
5. WHEN JOINING A RCP CONNECTOR PIPE TO A CSP CONNECTOR PIPE, THE INSIDE DIAMETER D OF THE CSP SHALL BE AT LEAST EQUAL TO BUT NOT MORE THAN 75 mm (3") GREATER THAN THAT OF THE RCP.
6. CONNECTOR PIPES SHALL BE NOT MORE THAN 1.5 m (5') ABOVE THE INVERT.
7. CONNECTOR PIPES SHALL ENTER MAIN LINE RCP RADIALLY.
8. WHEN CONNECTING TO A RCB, SPPWC 333 SHALL BE USED IF THE TOP OF THE CONNECTOR PIPE IS LESS THAN 300 mm (12") BELOW THE SOFFIT OF THE RCB OR THE FLOW LINE OF THE PIPE IS LESS THAN 330 mm (13") ABOVE THE FLOOR OF THE RCB AT THE INSIDE FACE.

CASE 2

9. SADDLE CONNECTIONS SHALL BE USED WHEN CONNECTING TO PIPES 525 mm (21") OR LESS IN DIAMETER WITHOUT THE USE OF JUNCTION STRUCTURES OR PRECAST Y BRANCHES.
10. TRIM OR CUT SADDLE TO FIT SNUGLY OVER THE OUTSIDE OF THE MAIN PIPE SO ITS AXIS WILL BE ON THE LINE AND GRADE OF THE CONNECTING PIPE.
11. THE OPENING INTO THE PIPE SHALL BE CUT AND TRIMMED TO FIT THE SADDLE SO THAT NO PART WILL PROJECT WITHIN THE BORE OF THE SADDLE PIPE.
12. THE CONNECTOR PIPE SHALL BE SUPPORTED AS SHOWN IN CASE 1 AND CASE 3.

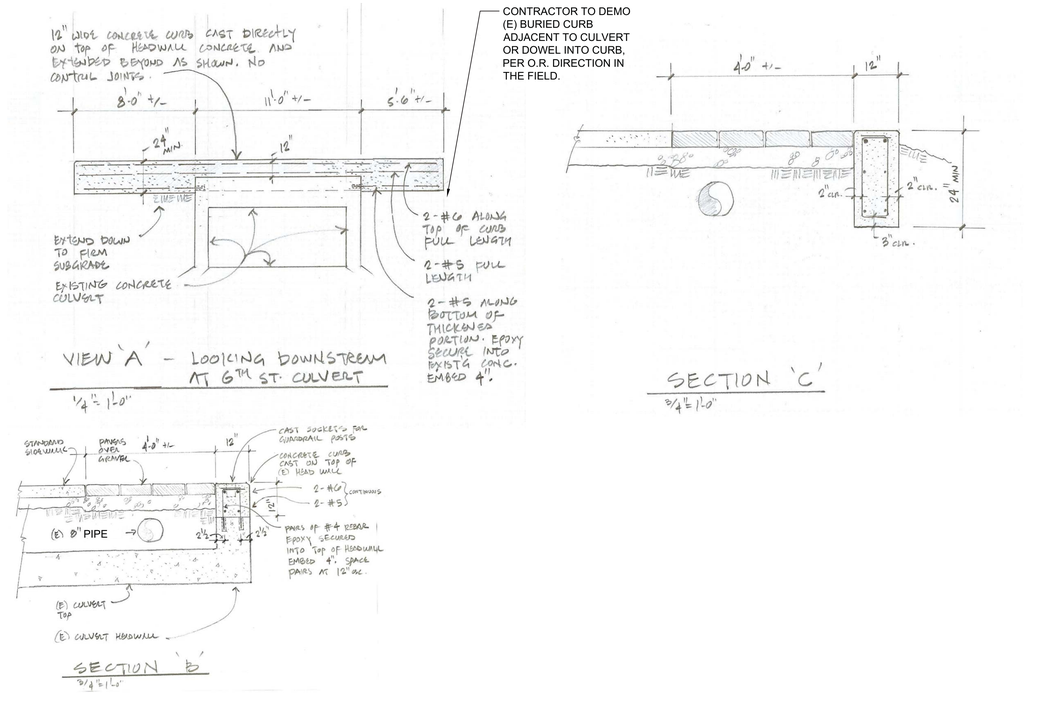
STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION

PIPE CONNECTIONS TO EXISTING STORM DRAINS

STANDARD PLAN METRIC 335–1 SHEET 2 OF 3

3 PIPE CONNECTION TO (E) CULVERT

SCALE: NTS



4 PAVERS AT SIXTH STREET EAST HEADWALL

SCALE: NTS

DATE	NO.	REVISIONS
10.22.10	1	CONCRETE PAVERS / DIMENSIONING
11.24.10	2	REMOVED SPEED TABLE / GRADING / BULB OUT
11.30.10	3	RESOLVE WATER LINE / DRAIN PIPE CONFLICTS

RDG
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LOWER CODORNICES CREEK - PHASE III
CREEK RESTORATION & SITE IMPROVEMENTS PLAN

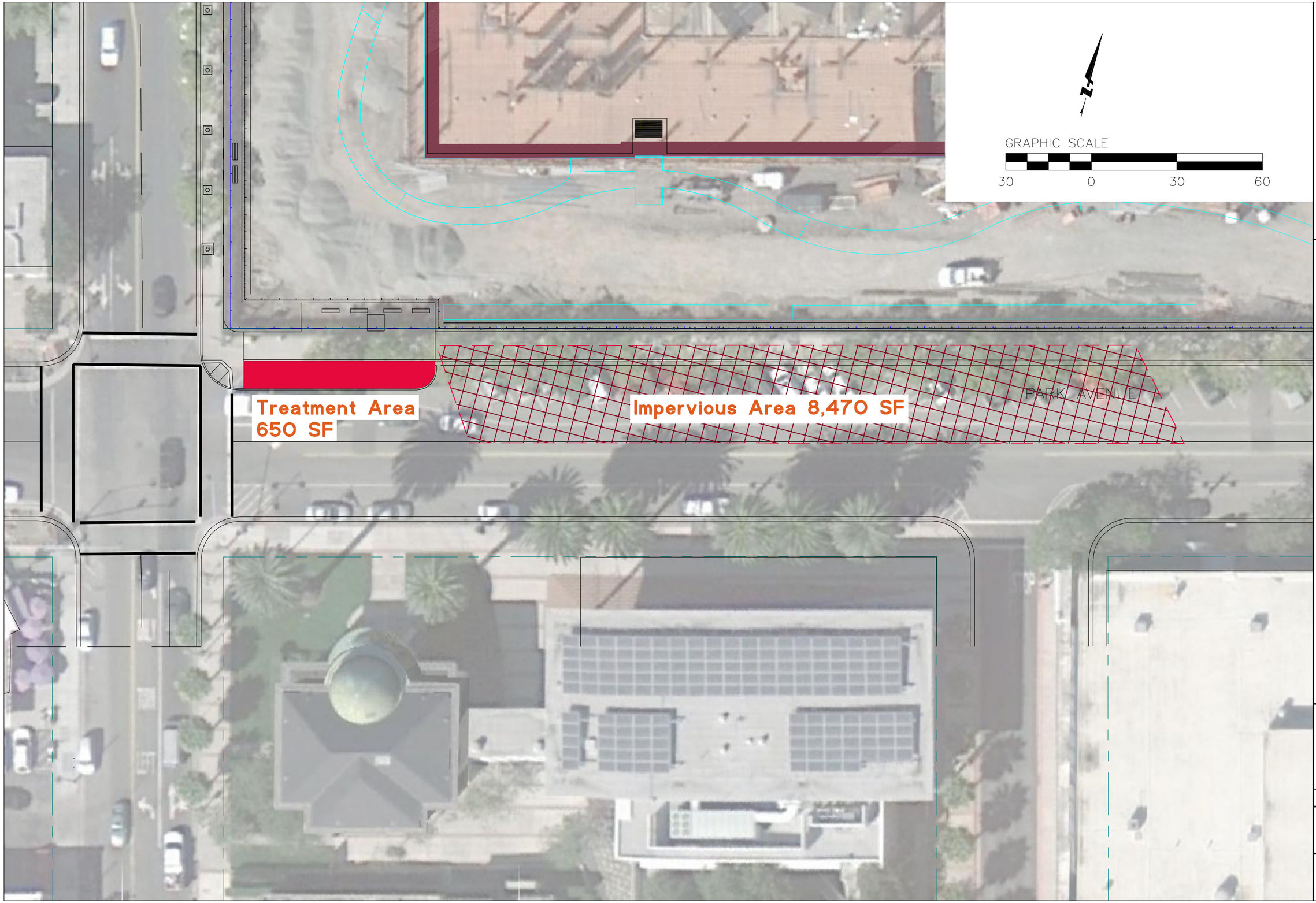
CITY OF ALBANY / CITY OF BERKELEY / UNIVERSITY OF CALIFORNIA BERKELEY

CONSTRUCTION SET

NOVEMBER 30, 2010

REVISED 6TH STREET DETAILS

SHEET R-2



GRAPHIC SCALE

30 0 30 60

BKF
ENGINEERS/SURVEYORS/PLANNERS
255 SHORELINE DRIVE, STE 200
REDWOOD CITY, CA 94065
650/482-6300
650/482-6399 (FAX)

PIXAR PHASE II
STORMWATER QUALITY EXHIBIT
PARK AND HOLLIS STORMWATER CURB EXTENSION

EMERYVILLE ALAMEDA COUNTY CALIFORNIA

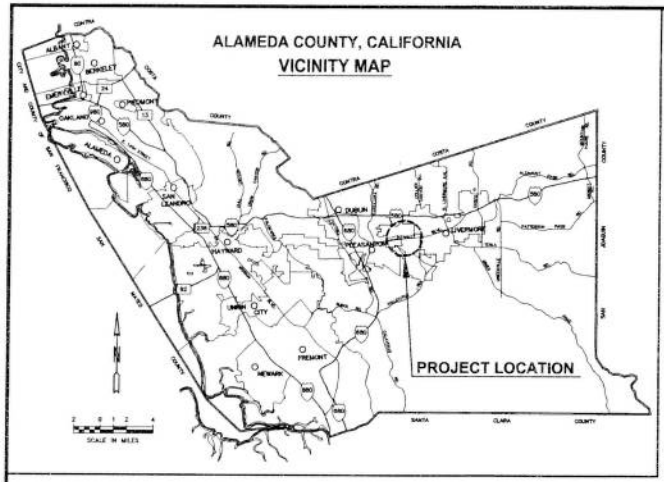
No.	Revisions

Date
Scale
Design
Drawn
Approved
Job No

Sheet Number:

1 OF 1

DRAWING NAME: K:\Eng07\070128\DWG\SWPPP\Treatment Areas\Park and Hollis Exhibit.dwg
PLOT DATE: 09-01-11
PLOTTED BY: som



ALAMEDA COUNTY
PUBLIC WORKS AGENCY

MAY 2010

STANLEY BOULEVARD

SAFETY & STREETSCAPE IMPROVEMENT PROJECT

BETWEEN THE CITY LIMITS OF PLEASANTON & LIVERMORE

MURRAY TOWNSHIP

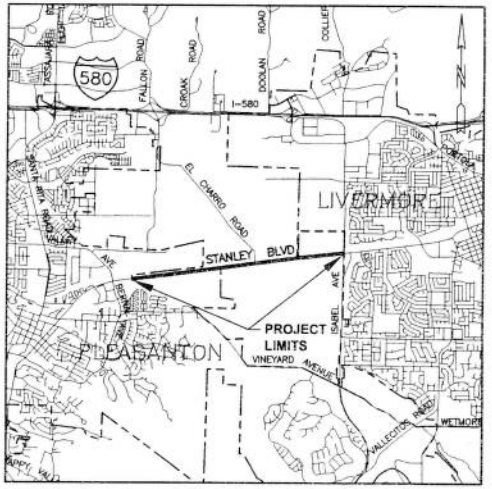
ALAMEDA COUNTY, CALIFORNIA

INDEX OF SHEETS

CONVENTIONAL SYMBOLS

PROPERTY, RIGHT OF WAY AND EASEMENT LINES OTHER THAN THOSE FOR PROJECT
PROJECT RIGHT OF WAY AND EASEMENT LINES
CONSTRUCTION CENTER LINE 10 11
TRAVERSE OR SURVEY LINE AND MONUMENT
CENTER LINE
CENTER LINE OF CHANNEL, CREEK, OR DITCH
TOE OF FILL OR SLOPE
TOP OF CUT OR BANK
CONCRETE CHANNEL
ROAD
EDGE OF PAVEMENT EP
PCC EXTRUDED CURB OR AC BERM
PCC SIDEWALK, CURB GUTTER & DRIVEWAY
GUARD RAIL OR BARRICADE
FENCE (SPECIFY TYPE) X X
CHAIN-LINK FENCE o o
RAILROAD
BUILDING
SHRUBBERY
MAIL BOX
TREE
TREE TO BE REMOVED
CHANNEL SLOPE

EXISTING UTILITIES:
WATER W
GAS G
SANITARY SEWER SS
OIL OL
GASOLINE GS
STORM DRAIN SD
ELECTRICAL E
ELECTRICAL UNDERGROUND E
TELEPHONE T
TELEPHONE UNDERGROUND T
FIBER OPTIC UNDERGROUND FO
CABLE TV CTV
CABLE TV UNDERGROUND CTV
TRANSMISSION LINE AND TOWER
DROP INLET DI
ELECTROLIER
FIRE HYDRANT
MANHOLE MH
MONUMENT EXISTING PROPOSED
UTILITY POLES:
JOINT POLE JP
POWER POLE PP
TELEPHONE POLE TP
GUY POLE GP
RIGHT OF WAY MARKER
ROADWAY SIGN
STREET NAME SIGN
WATER METER WM
WATER VALVE WV



LOCATION MAP
NO SCALE

- THE CONTRACTOR SHALL POSSESS A CLASS A LICENSE AT THE TIME THIS CONTRACT IS AWARDED.

CONSTRUCTION AREA SIGNS

TYPE	QUANTITY	DESCRIPTION	DIMENSION (in)
G20-2	2	END ROAD WORK	60 x 24
W20-1	2	ROAD WORK	48 x 48
C30 (CA)	2 (MIN.)	LANE CLOSED	36 x 36

DANIEL WOLDESENBET, Ph.D., P.E.
COUNTY ENGINEER
CIVIL ENGINEER CERTIFICATE NO. 60306
EXPIRATION JUNE 30, 2010

6/2/10
PLAN APPROVAL DATE

REVISIONS

NO.	DESCRIPTION	BY	DATE	APP'D
1				
2				
3				
4				

COUNTY OF ALAMEDA ☆ PUBLIC WORKS AGENCY

TITLE SHEET

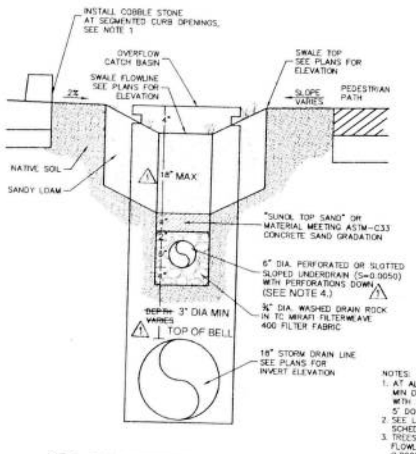
SCALE	AS SHOWN
DATE	MAY 2010
WORK ORDER NO.	R32064
SPECIFICATION NO.	2125
SHEET NO.	1.01 OF 194
FILE NO.	U-324-12

	REVIEWED BY:	DATE:
CONSTRUCTION		
MAINTENANCE		
REAL ESTATE		

	REVIEWED BY:	DATE:
SURVEY		
TRAFFIC		
ENVIRONMENTAL		

N:\C30\ROAD\R32064-Stanley Safety\Dwgs\Sheet 1 Title Sheet.dwg 6-02-10 02:15:16 PM jsand

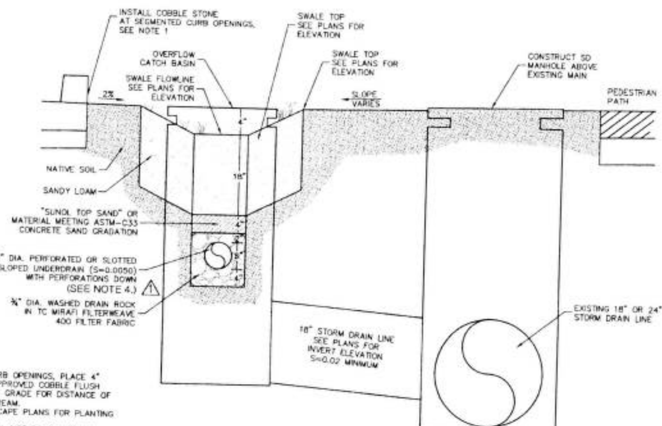
FOR REDUCED ENGLISH PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3



INSTALL COBBLE STONE AT SEGMENTED CURB OPENINGS, SEE NOTE 1
OVERFLOW CATCH BASIN
SWALE FLOWLINE SEE PLANS FOR ELEVATION
SWALE TOP SEE PLANS FOR ELEVATION
SLOPE VARIES
PEDESTRIAN PATH
2%
4"
NATIVE SOIL
SANDY LOAM
18" MAX
"SUNOL TOP SAND" OR MATERIAL MEETING ASTM-C33 CONCRETE SAND GRADATION
6" DIA. PERFORATED OR SLOTTED SLOPED UNDERDRAIN (S=0.0050) WITH PERFORATIONS DOWN (SEE NOTE 4.)
¾" DIA. WASHED DRAIN ROCK IN TC MIRAFI FILTERWEAVE 400 FILTER FABRIC
DEPTH VARIES 3" DIA MIN
TOP OF BELL
18" STORM DRAIN LINE SEE PLANS FOR INVERT ELEVATION

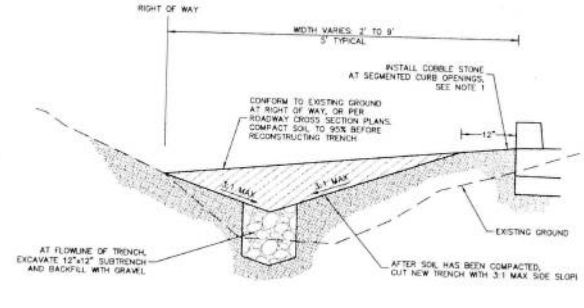
1 **BIO RETENTION SECTION**
SOUTHSIDE – ABOVE MAINLINE
NTS

NOTES:
1. AT ALL CURB OPENINGS, PLACE 4" MIN DIA. APPROVED COBBLE FLUSH WITH FINISH GRADE FOR DISTANCE OF 5' DOWNSTREAM.
2. SEE LANDSCAPE PLANS FOR PLANTING SCHEDULE.
3. TREES SHALL NOT BE PLANTED IN FLOWLINE IF SLOPE IS LESS THAN 0.0020 OR IF SWALE FLOOR WIDTH IS LESS THAN 4'.
4. PERFORATED PIPE SHALL BE ALIGNED CENTERED WITH SWALE.



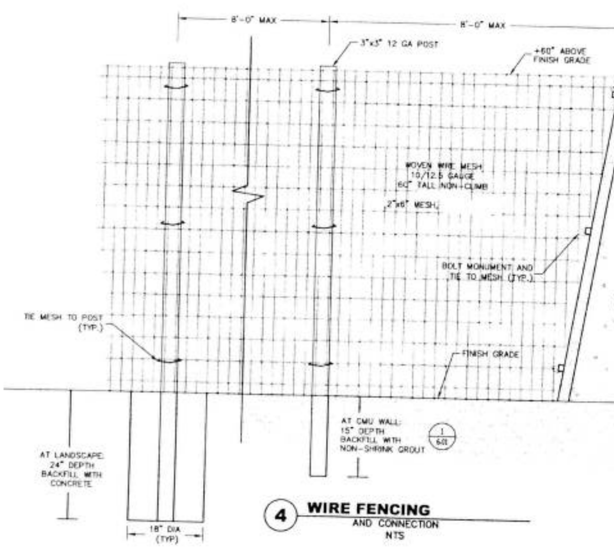
INSTALL COBBLE STONE AT SEGMENTED CURB OPENINGS, SEE NOTE 1
OVERFLOW CATCH BASIN
SWALE FLOWLINE SEE PLANS FOR ELEVATION
SWALE TOP SEE PLANS FOR ELEVATION
SWALE TOP SEE PLANS FOR ELEVATION
CONSTRUCT SD MANHOLE ABOVE EXISTING MAIN
SLOPE VARIES
PEDESTRIAN PATH
2%
NATIVE SOIL
SANDY LOAM
18"
"SUNOL TOP SAND" OR MATERIAL MEETING ASTM-C33 CONCRETE SAND GRADATION
6" DIA. PERFORATED OR SLOTTED SLOPED UNDERDRAIN (S=0.0050) WITH PERFORATIONS DOWN (SEE NOTE 4.)
¾" DIA. WASHED DRAIN ROCK IN TC MIRAFI FILTERWEAVE 400 FILTER FABRIC
18" STORM DRAIN LINE SEE PLANS FOR INVERT ELEVATION S=0.02 MINIMUM
EXISTING 18" OR 24" STORM DRAIN LINE

2 **BIO RETENTION SECTION**
SOUTHSIDE – OFFSET MAINLINE
NTS



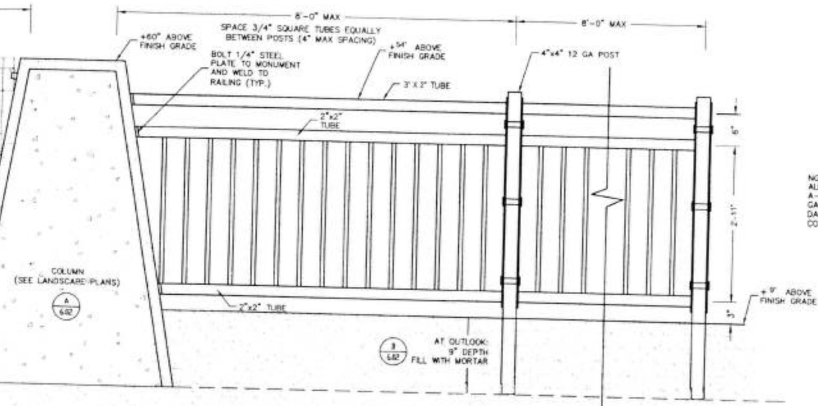
RIGHT OF WAY
WIDTH VARIES: 2' TO 9' 5' TYPICAL
INSTALL COBBLE STONE AT SEGMENTED CURB OPENINGS, SEE NOTE 1
CONFORM TO EXISTING GROUND AT RIGHT OF WAY, OR PER ROADWAY CROSS SECTION PLANS. COMPACT SOIL TO 95% BEFORE RECONSTRUCTING TRENCH
12"
3:1 MAX
3:1 MAX
EXISTING GROUND
AT FLOWLINE OF TRENCH, EXCAVATE 12"x12" SUBTRENCH AND BACKFILL WITH GRAVEL
AFTER SOIL HAS BEEN COMPACTED, CUT NEW TRENCH WITH 3:1 MAX SIDE SLOPE

3 **TRENCH SECTION**
NORTHSIDE
NTS



8'-0" MAX
8'-0" MAX
3"x3" 12 GA POST
+60" ABOVE FINISH GRADE
WOVEN WIRE MESH 10/12.5 GAUGE 60" TALL NON-CLIMB
2"x6" MESH
BOLT MONUMENT AND TIE TO MESH (TYP.)
TIE MESH TO POST (TYP.)
FINISH GRADE
AT CMU WALL: 15" DEPTH BACKFILL WITH NON-SHRINK GROUT
AT LANDSCAPE: 24" DEPTH BACKFILL WITH CONCRETE
18" DIA (TYP)

4 **WIRE FENCING**
AND CONNECTION
NTS



8'-0" MAX
8'-0" MAX
+60" ABOVE FINISH GRADE
SPACE 3/4" SQUARE TUBES EQUALLY BETWEEN POSTS (4" MAX SPACING)
+54" ABOVE FINISH GRADE
4"x4" 12 GA POST
BOLT 1/4" STEEL PLATE TO MONUMENT AND WELD TO RAILING (TYP.)
3" X 3" TUBE
2"x2" TUBE
COLUMN (SEE LANDSCAPE PLANS)
2"x2" TUBE
6"
2'-11"
3"
+9" ABOVE FINISH GRADE
AT OUTLOOK: 9" DEPTH FILL WITH MORTAR

5 **METAL RAILING**
AND CONNECTION – AT OVERLOOK
NTS

NOTE:
ALL MATERIALS TO BE ASTM A-500 GRADE-B HOT DIPPED GALVANIZED 14-GAUGE STEEL DARK BROWN, FLAT POWDER COAT FINISH

REVIEWED BY:	DATE:		REVIEWED BY:	DATE:
CONSTRUCTION		SURVEY		
MAINTENANCE		TRAFFIC		
REAL ESTATE		ENVIRONMENTAL		

REVISIONS

NO.	DESCRIPTION	BY	DATE	APPVD
1	REVISION TO BIO RETENTION SECTION 1	BN	8/22/11	

BKF

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY

STANLEY BOULEVARD
SAFETY & STREETSCAPE IMPROVEMENT PROJECT
BETWEEN THE CITY LIMITS OF PLEASANTON & LIVERMORE

DRAINAGE AND GRADING PLAN AND DETAILS

WORK ORDER NO. R32064
SPECIFICATION NO. 2125
SHEET NO. 7.27 OF 194
FILE NO. U-324-12

FOR REDUCED ENGLISH PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

DONNELLY AVENUE
(50' RIGHT-OF-WAY)

INSTALL Conc. TRENCH DRAIN WITH NON-SLIP GRATE LOAD CLASS A ADA COMPLIANT "HEEL SAFE WITH OPENINGS LESS THAN 0.25" (TOTAL 3) SEE DETAIL 2/11

CURB AND GUTTER SEE DETAIL 6/14 MATCH Exist

PARKING METERS POST METER HEADS TO BE FURNISHED AND INSTALLED BY THE CITY, (TOTAL 2 ON-STREET)

CURB EXTENSION SEE SHEET 8

PROTECT Exist Conc. SIDEWALK

2'X2' REINFORCED CONCRETE BASE AROUND EXIST WATER VALVE SEE CITY TYPICAL W-1809

BOARDWALK WITH SIDEGUARDS, STRUCTURES, FOOTINGS, AND CONNECTIONS, TO BE DESIGNED AND INSTALLED BY DESIGN BUILD CONTRACTOR, SEE DETAIL 6/13 FOR VISUAL EXAMPLE (TOTAL 2)

PROTECT Exist DRIVEWAY

Exist PM TO REMAIN

SAWCUT LINE

INSTALL 6"x16" VERTICAL CURB

PROTECT Exist SIDEWALK

LOCATE AND VERIFY DEPTH OF JOINT TRENCH

Exist PM TO REMAIN

BACK OF SIDEWALK

ADJUST Exist WM

4"-8" ROUNDED RIVER ROCK, TYP.

ADJUST Exist WM

INSTALL RPB SEE DETAIL X.X/X

LOCATE AND VERIFY DEPTH OF GAS LINE

Exist WM TO REMAIN

INSTALL 6"x16" VERTICAL CURB SEE DETAIL 1/14

INSTALL 6"x16" VERTICAL CURB SEE DETAIL 1/X

Exist PM TO REMAIN CONC.

Exist PM TO REMAIN TYP.

BEGIN FLUSHED 6"X14"CONCRETE CURB

SIGN POST, TYP. (BY OTHERS)

SAWCUT LINE

FLUSHED 6"X14" CONCRETE CURB SEE DETAIL 2/X

6.0' WHEEL STOP SEE DETAIL 4/12 (TOTAL 17)

END FLUSHED CONCRETE CURB

RELOCATED 4.0' WHEEL STOP (TOTAL 11)

ELECTRICAL CONDUIT BOX SEE ELECTRICAL PLANS

ELECTRICAL CONDUIT BOX SEE ELECTRICAL PLANS

Exist SIGN TO REMAIN

Exist LP TO REMAIN

INSTALL NEW STREET LIGHT (TO BE PROVIDED BY THE CITY). SEE ELECTRICAL PLANS.

RELOCATE STREET LIGHT SEE ELECTRICAL PLANS

RELOCATE STREET LIGHT. SEE ELECTRICAL PLANS.

INSTALL NEW PM POST, TYP.

Exist SIGN TO REMAIN CONC.

RELOCATE STREET LIGHT SEE ELECTRICAL PLANS

INSTALL PARKING METERS POST METER HEADS TO BE FURNISHED AND INSTALLED BY THE CITY, (TOTAL 39 IN PARKING LOT)

ABANDON Exist ELECTRICAL LINE. SEE ELECTRICAL PLANS.

NOTE:

1. FOR GENERAL NOTES, LEGEND, AND ABBREVIATIONS, SEE SHEET 2.
2. ALL ANGLES ARE 45 DEGREE, 90 DEGREE, OR 135 DEGREE UNLESS OTHERWISE NOTED.
3. ALL CURVES AND ALL TRANSITIONS BETWEEN CURVES AND STRAIGHT EDGES SHALL BE SMOOTH.
4. EXPANSION JOINTS FOR PLANTER CURBS SHALL LINE UP WITH PAVEMENT PATTERN.
5. FOR ADDITIONAL LIGHTING INFORMATION, SEE ELECTRICAL PLANS.

GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)
1 INCH = 10 FT

CITY OF BURLINGAME
PUBLIC WORKS
501 PRIMROSE ROAD
BURLINGAME, CA 94010
650.558.7230
650.685.9310 (FAX)

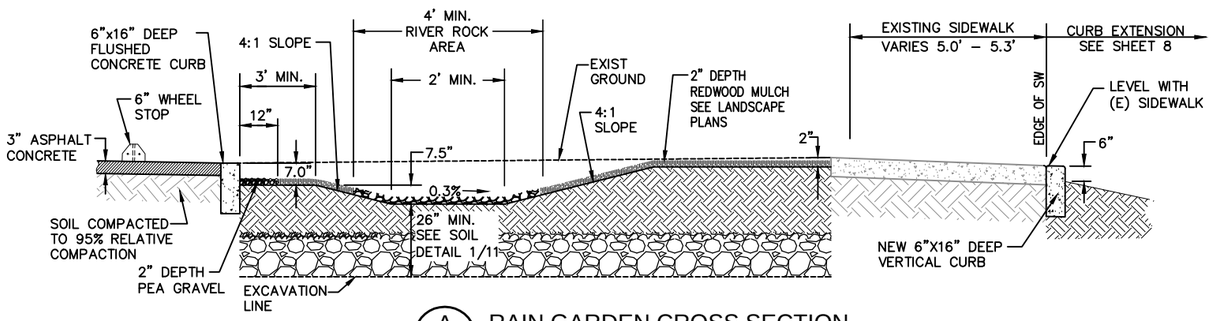
DONNELLY AVENUE - PARKING LOT C
STORMWATER GARDEN
BURLINGAME SAN MATEO COUNTY CALIFORNIA

Revisions
No.

Date: 11/17/09
Scale: 1"=10'
Design By:
Drawn By: LM
Checked By: JG
Project No.: 82340

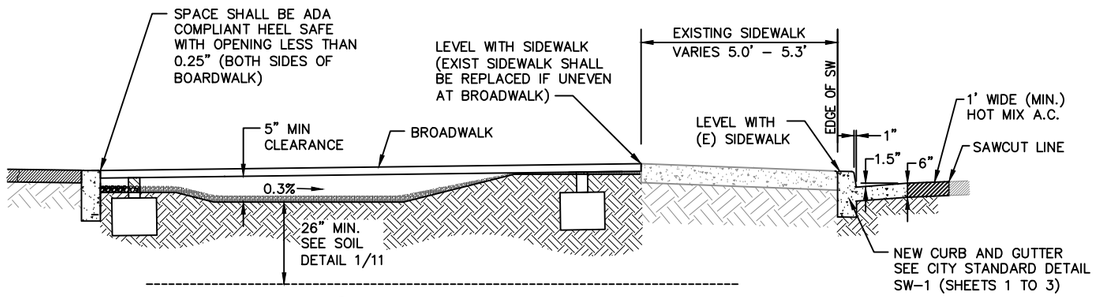
DRAWING TITLE: LAYOUT

Drawing Number:
5 OF 16



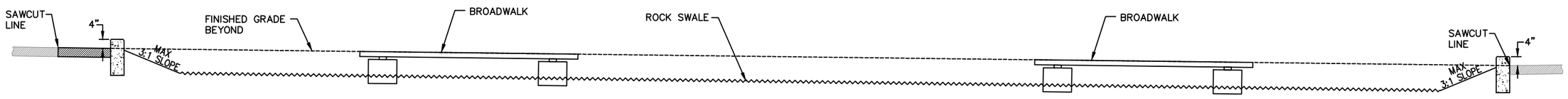
A/11 RAIN GARDEN CROSS SECTION

NOT TO SCALE



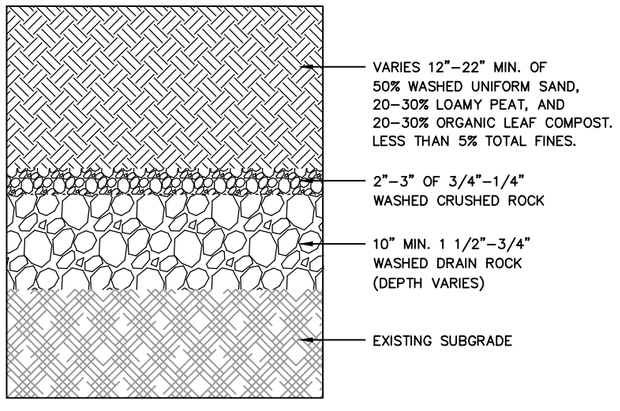
B/11 RAIN GARDEN CROSS SECTION

NOT TO SCALE



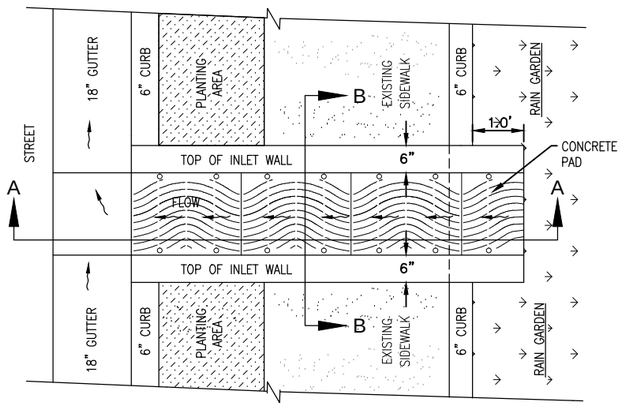
C/10 RAIN GARDEN CROSS SECTION

NOT TO SCALE

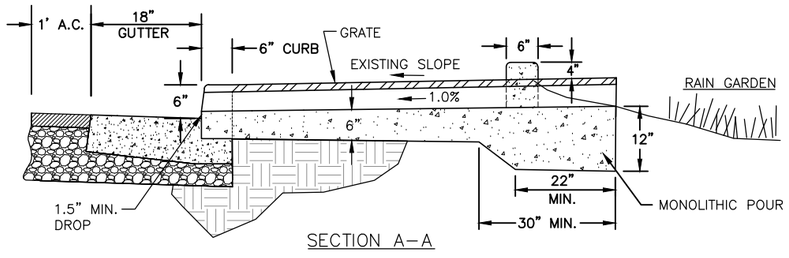


1/10 SOIL PROFILE

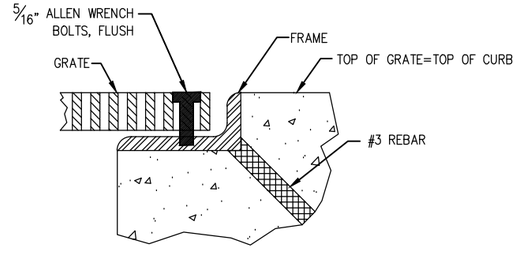
NOT TO SCALE



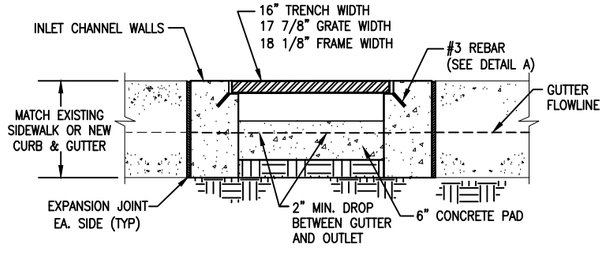
PLAN VIEW



SECTION A–A



DETAIL A



NOTE: MAXIMUM GRATE HOLE WIDTH (OPEN) 1/4 INCH. GRATE SIZE 18"X24". CAST IRON URBAN ACCESSORIES TRENCH GRATE AND FRAME. TITLE WAVE MODEL OR APPROVED EQUAL.

SECTION B–B

2/10 CONCRETE OUTLET

NOT TO SCALE

CITY OF BURLINGAME
PUBLIC WORKS
501 PRIMROSE ROAD
BURLINGAME, CA 94010
650.558.7230
650.685.9310 (FAX)

DONNELLY AVENUE – PARKING LOT C

STORMWATER GARDEN

BURLINGAME SAN MATEO COUNTY CALIFORNIA

Revisions

No.

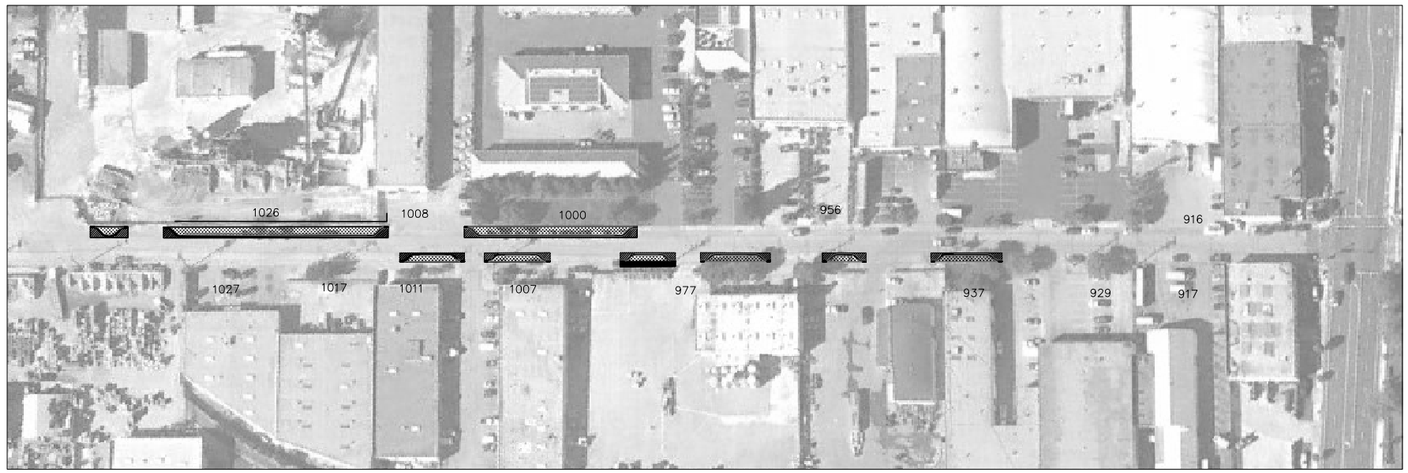
Date:	11/19/09
Scale:	AS SHOWNS
Design By:	
Drawn By:	
Checked By:	
Project No.:	82340

DRAWING TITLE: DETAILS

Drawing Number: 11 OF 16

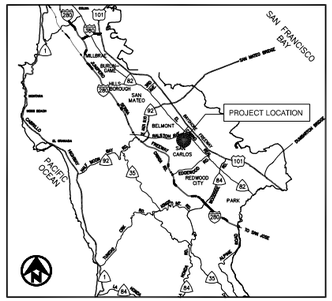
PROJECT TITLE

BRANSTEN ROAD
CURB EXTENSION AND STORWATER TREATMENT
SAN CARLOS, CA



LIMITS OF WORK

LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS

SHEET NO.	SHEET ID	PLAN & TITLE
1	T	TITLE SHEET, LOCATION MAP AND GENERAL NOTES
2	X	TYPICAL SECTIONS
3 - 6	L	LAYOUT PLAN
7 - 10	D	DRAINAGE PLAN
11 - 19	C	CONSTRUCTION DETAILS
20 - 22	I	IRRIGATION PLAN, NOTES AND DETAILS
23 - 25	P	IPLANTING PLAN, NOTES AND DETAILS

GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE CITY OF SAN CARLOS STANDARD SPECIFICATIONS 2008 EDITION.
2. THE CONTRACTOR IS RESPONSIBLE FOR THE INTENT OF THESE PLANS AND SHALL REPORT ANY DISCREPANCIES FOUND IN THEM TO THE ENGINEER PRIOR TO CONSTRUCTION.
3. IT IS CONTRACTOR'S RESPONSIBILITY TO VERIFY THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES WITH THE APPROPRIATE UTILITY AGENCIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. CONTRACTOR SHALL NOTIFY ALL PUBLIC AND PRIVATE UTILITY OWNERS 48 HOURS PRIOR TO COMMENCEMENT OF WORK ADJACENT TO THE UTILITY. CONTACT SERVICE ALERT (USA) AT 800-642-2444.

SURVEY CONTROL:

BENCHMARK IS THE CENTER OF THE FIRE HYDRANT AT THE SOUTHEAST CORNER OF BRANSTEN ROAD AND INDUSTRIAL ROAD STATION 19.703' RT "BRN"
LINE 14+42.00 LATITUDE 37°30'26.53"
LONGTITUDE -122°15'06.75" TOP OF HYDRANT
ELEVATION + 9.82; CITY OF SAN CARLOS DATUM.

ADDITIONAL REFERENCE POINT:

EXISTING DRAINAGE INLET AT 18.033' LT "BRN" LINE 7+27.74, GRATE ELEVATION +7.68.

LINE 14+42.00 LATITUDE 37°30'26.53"
LONGTITUDE -122°15'06.75" TOP OF HYDRANT
ELEVATION + 9.82; CITY OF SAN CARLOS DATUM.

JAY WALTER, P.E.
PUBLIC WORKS DIRECTOR/CITY ENGINEER
PUBLIC WORKS DEPARTMENT

AUTHORIZED FOR CONSTRUCTION: _____

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE
1	08/22/12	AC/AO	65%
2	10/19/12	AC/AO	95%
3	03/04/13	AC/AO	100%

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

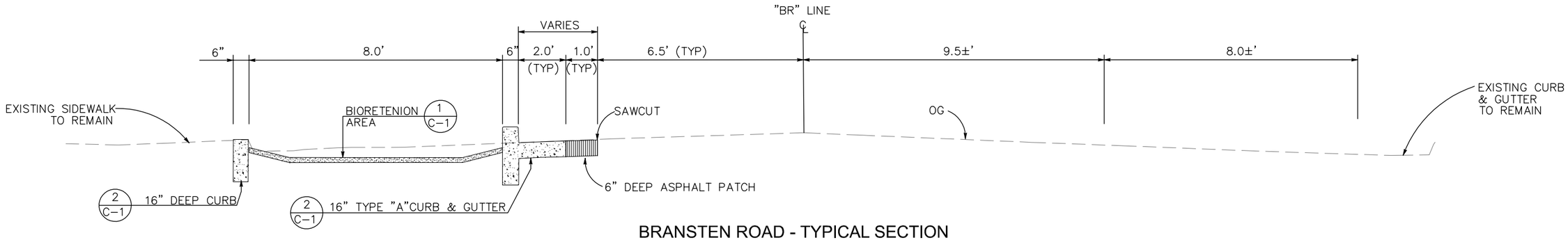
FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY	AO
DESIGNED BY	AC
DRAWN BY	VP

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/04/2013

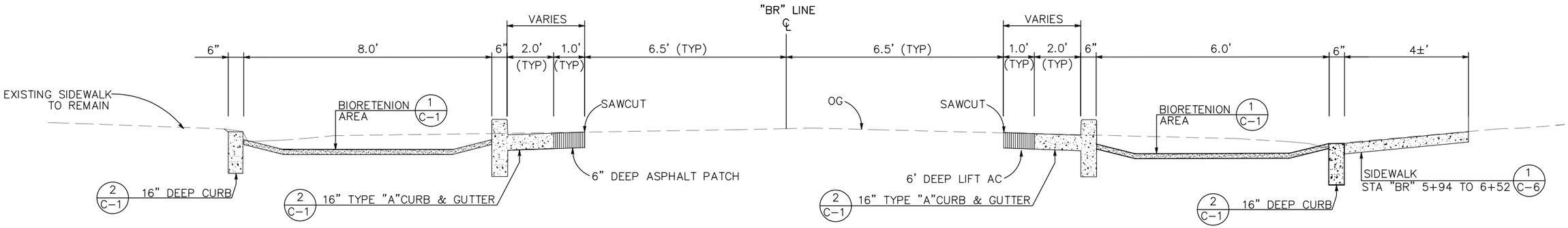
BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT
SAN CARLOS, SAN MATEO COUNTY, CA
TITLE SHEET, LOCATION MAP, AND GENERAL NOTES

T-1
SHEET NO.
1 OF 25



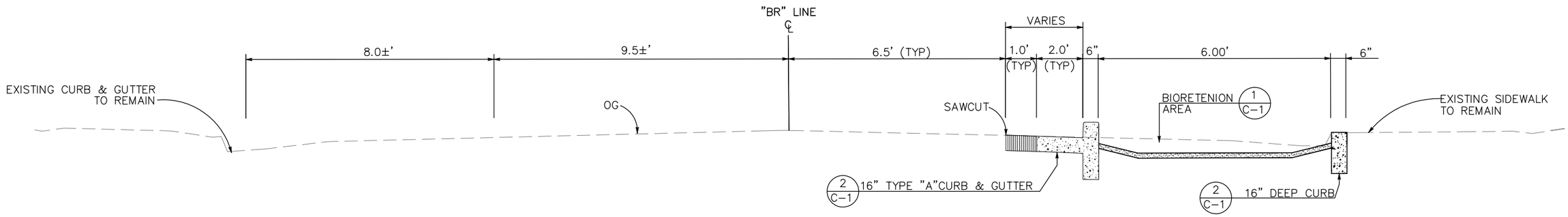
BRANSTEN ROAD - TYPICAL SECTION

STA "BR" 0+40 TO 3+60



BRANSTEN ROAD - TYPICAL SECTION

STA "BR" 3+60 TO 6+55



BRANSTEN ROAD - TYPICAL SECTION

STA "BR" 6+55 TO 10+00

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE
1	08/22/12	AC/AO	65%
2	10/19/12	AC/AO	95%
3	03/04/13	AC/AO	100%

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY	AO
DESIGNED BY	AC
DRAWN BY	VP

REGISTERED PROFESSIONAL ENGINEER
ANNALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/04/2013

BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT
SAN CARLOS, SAN MATEO COUNTY, CA

TYPICAL SECTIONS

X-1

SHEET NO. 2 OF 25

PROJECT TITLE

NOTES:

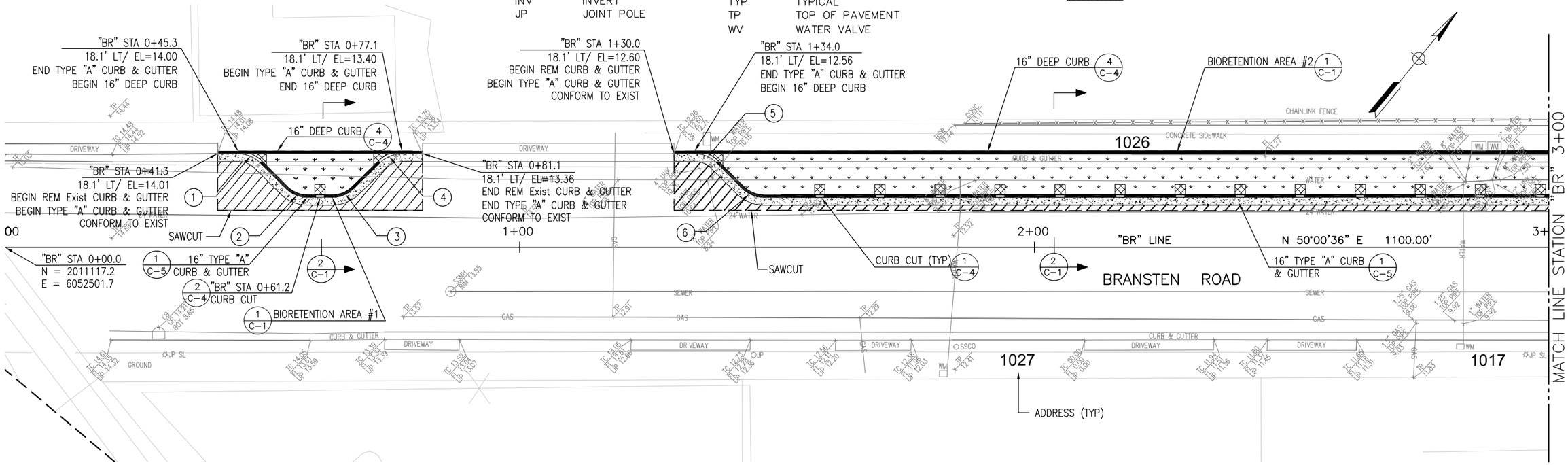
1. ELEVATIONS ON THE PLANS ARE FLOWLINES AT THE FACE OF CURBS.
2. CONTRACTOR TO COORDINATE WITH CITY ENGINEER FOR ALLOWABLE STAGING LOCATIONS.
3. CONSTRUCT ONE SIDE OF BRANSTEN ROAD AT A TIME TO ALLOW FOR ONE-WAY TRAFFIC CONTROL.
4. CONTRACTOR TO ALLOW DRIVEWAY ACCESS AT ALL TIMES DURING CONSTRUCTION.
5. CURVE DATA IS MEASURED FROM OUTSIDE FACE OF CURB.

ABBREVIATIONS:

AB	AGGREGATE BASE	LF	LINEAR FEET
AC	ASPHALT CONCRETE	MAX	MAXIMUM
BC	BEGIN CURVE	MIN	MINIMUM
BFP	BACKFLOW PREVENTION	MOD	MODIFIED
BOT	BOTTOM	OG	ORIGINAL GRADE
BSW	BACK OF SIDEWALK	PCC	PORTLAND CEMENT CONCRETE
CL	CLASS	REM	REMOVE
CONC	CONCRETE	SW	SIDEWALK
EC	END CURVE	SD	STORM DRAIN
ELEV	ELEVATION	SL	STREET LIGHT
FG	FINISHED GRADE	STA	STATION
FL	FLOWLINE ELEVATION	STD	CITY OF SAN CARLOS STANDARD
GR	GRATE	TC	TOP OF CURB
INV	INVERT	TYP	TYPICAL
JP	JOINT POLE	TP	TOP OF PAVEMENT
		WV	WATER VALVE

LEGEND:

- SAWCUT LINE
- TYPE "A" CURB OR 16" DEEP CURB
- CURB CUT
- TYPE "A" CURB GUTTER
- NEW ROADWAY PAVEMENT 6" AC (TYPE B), 12" CL 2 AB
- CONCRETE FOREBAY
- BIORETENTION AREA
- SIDEWALK



PLAN
SCALE: 1" = 10'

CURVE DATA

No.	BC STA	EC STA	RADIUS	DELTA	LENGTH	T
1	0+45.3	0+49.6	6.0'	45°00'00"	4.7'	2.5'
2	0+54.5	0+58.8	6.0'	45°00'00"	4.7'	2.5'
3	0+63.6	0+67.7	6.0'	45°00'00"	4.7'	2.5'
4	0+72.9	0+77.1	6.0'	45°00'00"	4.7'	2.5'
5	1+34.0	1+38.2	6.0'	45°00'00"	4.7'	2.5'
6	1+43.2	1+47.4	6.0'	45°00'00"	4.7'	2.5'

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY	AO
DESIGNED BY	AC
DRAWN BY	VP

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/01/2013

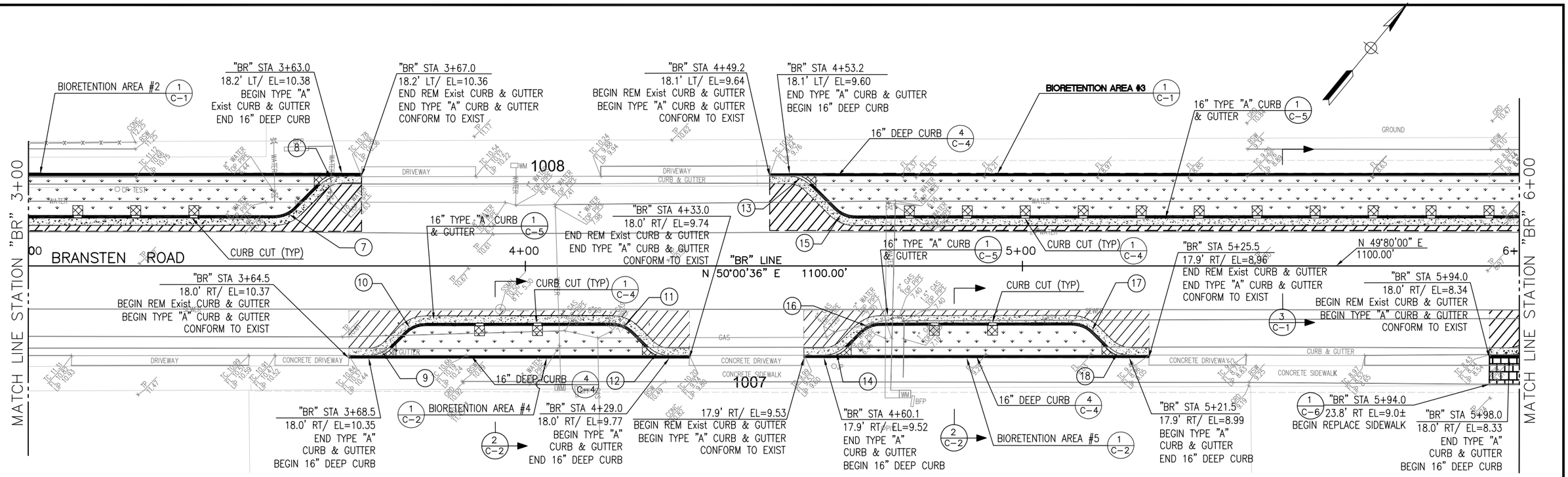
BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT SAN CARLOS, SAN MATEO COUNTY, CA

LAYOUT PLAN

L-1

SHEET NO. 3 OF 25

PROJECT TITLE



CURVE DATA						
No.	BC STA	EC STA	RADIUS	DELTA	LENGTH	T
7	3+49.5	3+53.8	6.0'	45°00'00"	4.7'	2.5'
8	3+58.8	3+63.0	6.0'	45°00'00"	4.7'	2.5'
9	3+68.5	3+72.7	6.0'	45°00'00"	4.7'	2.5'
10	3+75.7	3+79.9	6.0'	45°00'00"	4.7'	2.5'
11	4+13.4	4+21.4	6.0'	45°00'00"	4.7'	2.5'
12	4+24.8	4+29.0	6.0'	45°00'00"	4.7'	2.5'
13	4+53.2	4+57.2	6.0'	45°00'00"	4.7'	2.5'
14	4+60.1	4+64.3	6.0'	45°00'00"	4.7'	2.5'
15	4+62.2	4+66.4	6.0'	45°00'00"	4.7'	2.5'
16	4+67.2	4+71.5	6.0'	45°00'00"	4.7'	2.5'
17	5+10.0	5+14.3	6.0'	45°00'00"	4.7'	2.5'
18	5+17.3	5+21.5	6.0'	45°00'00"	4.7'	2.5'

PLAN
SCALE: 1" = 10'

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY AO
DESIGNED BY AC
DRAWN BY VP

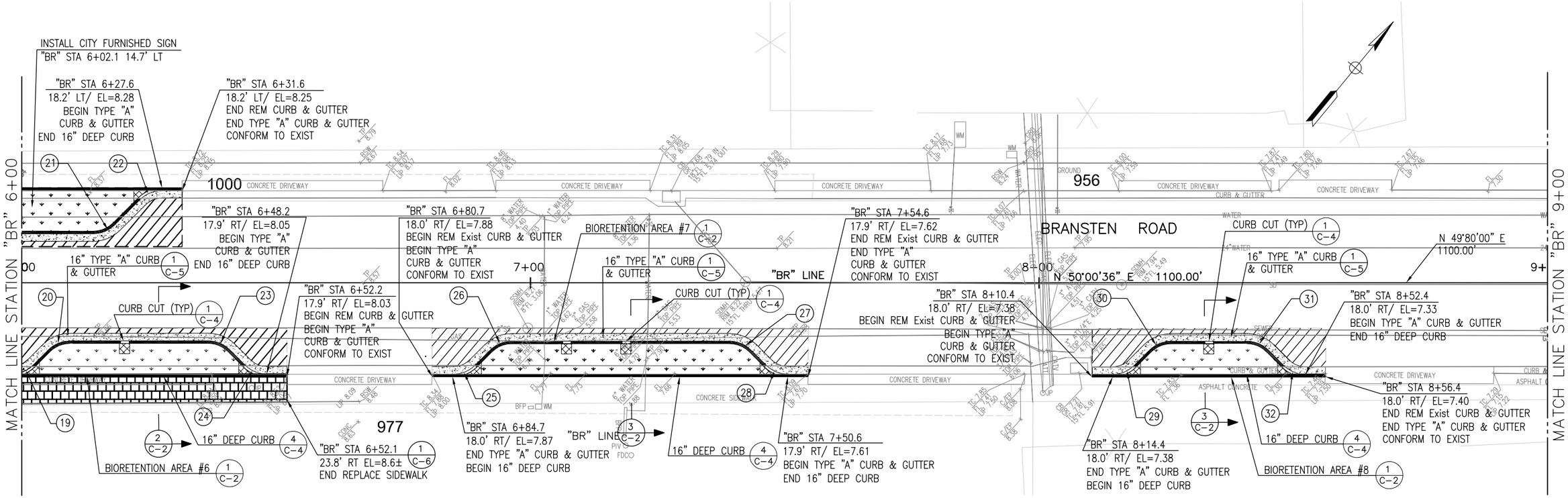
REGISTERED PROFESSIONAL ENGINEER
ANNALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/01/2013

BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT
SAN CARLOS, SAN MATEO COUNTY, CA

LAYOUT PLAN

L-2

SHEET NO. 4 OF 25



PLAN

SCALE: 1" = 10'

CURVE DATA						
No.	BC STA	EC STA	RADIUS	DELTA	LENGTH	T
(19)	5+98.0	6+02.2	6.0'	45°00'00"	4.7'	2.5'
(20)	6+05.2	6+09.5	6.0'	45°00'00"	4.7'	2.5'
(21)	6+14.1	6+18.3	6.0'	45°00'00"	4.7'	2.5'
(22)	6+23.3	6+27.5	6.0'	45°00'00"	4.7'	2.5'
(23)	6+36.1	6+40.9	6.0'	45°00'00"	4.7'	2.5'
(24)	6+43.9	6+48.1	6.0'	45°00'00"	4.7'	2.5'
(25)	6+84.9	6+89.1	6.0'	45°00'00"	4.7'	2.5'

CURVE DATA						
No.	BC STA	EC STA	RADIUS	DELTA	LENGTH	T
(26)	6+92.1	6+96.3	6.0'	45°00'00"	4.7'	2.5'
(27)	7+39.1	7+43.4	6.0'	45°00'00"	4.7'	2.5'
(28)	7+46.4	7+50.6	6.0'	45°00'00"	4.7'	2.5'
(29)	8+14.5	8+18.7	6.0'	45°00'00"	4.7'	2.5'
(30)	8+21.7	8+25.9	6.0'	45°00'00"	4.7'	2.5'
(31)	8+40.9	8+45.1	6.0'	45°00'00"	4.7'	2.5'
(32)	8+48.1	8+2.4	6.0'	45°00'00"	4.7'	2.5'

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY	AO
DESIGNED BY	AC
DRAWN BY	VP

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/01/2013

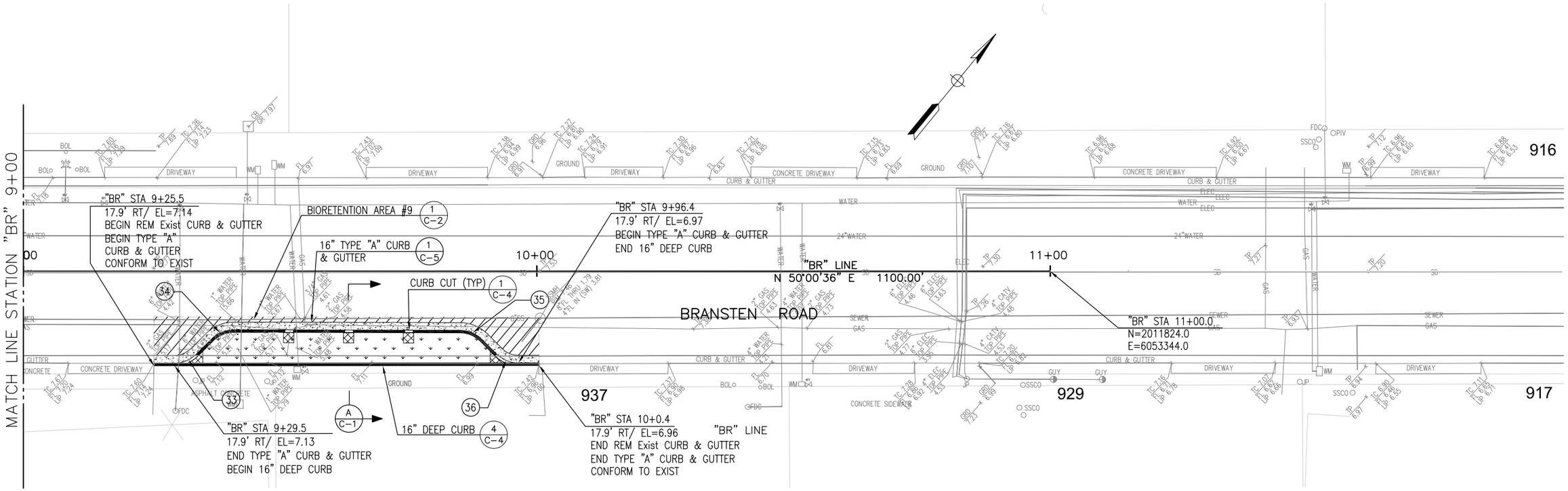
BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT
SAN CARLOS, SAN MATEO COUNTY, CA

LAYOUT PLAN

L-3

SHEET NO. 5 OF 25

PROJECT TITLE



PLAN

SCALE: 1" = 10'

CURVE DATA						
No.	BC STA	EC STA	RADIUS	DELTA	LENGTH	T
33	9+29.5	9+33.7	6.0'	45°00'00"	4.7'	2.5'
34	9+36.7	9+40.9	6.0'	45°00'00"	4.7'	2.5'
35	9+84.9	9+89.2	6.0'	45°00'00"	4.7'	2.5'
36	9+92.2	9+96.4	6.0'	45°00'00"	4.7'	2.5'

CITY OF SAN CARLOS
PUBLIC WORKS DEPARTMENT
600 ELM STREET
SAN CARLOS, CA 94070
(650) 802-4204

No.	DATE	BY	REFERENCE

WRECO
1243 ALPINE ROAD, SUITE 108
WALNUT CREEK, CA 94596
PH (925) 941-0017 FX (925) 941-0018

FOR: BAY AREA STORMWATER MANAGEMENT AGENCIES ASSOCIATION

CHECKED BY AO
DESIGNED BY AC
DRAWN BY VP

REGISTERED PROFESSIONAL ENGINEER
ANNALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
DATE: 03/01/2013

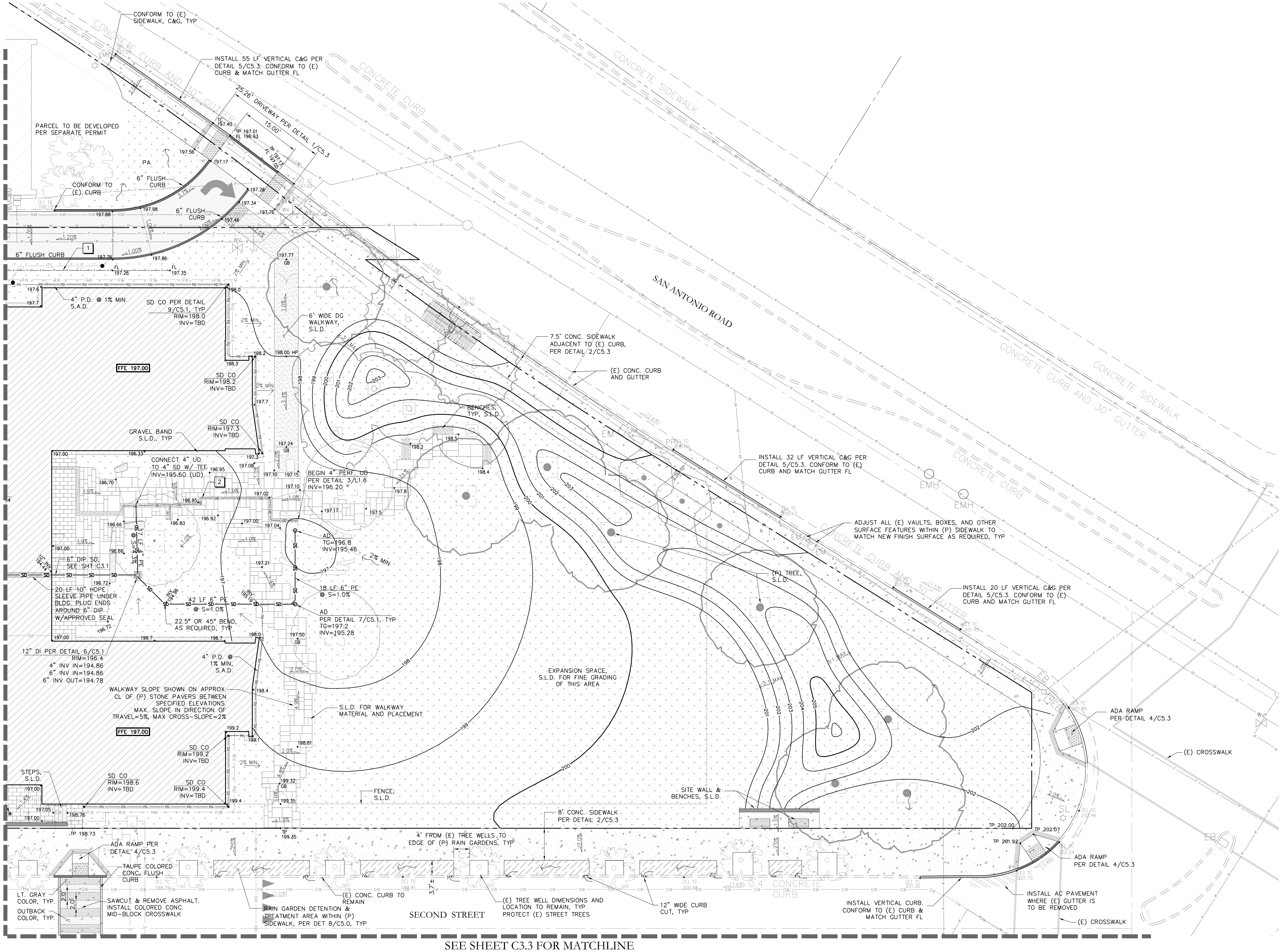
BRANSTEN ROAD CURB EXTENSION AND STORMWATER TREATMENT
SAN CARLOS, SAN MATEO COUNTY, CA

LAYOUT PLAN

L-4

SHEET NO. 6 OF 25

PROJECT TITLE



PLAN VIEW
Scale: 1" = 10'

LEGEND

	EXISTING	PROPOSED
EASEMENT		
LIMITS OF WORK		
MAJOR CONTOUR	180	890
MINOR CONTOUR		
PROPERTY LINE		
TOP OF PAVEMENT ELEVATION	(E) EP 198.95	EP 196.78
TOP OF CURB ELEVATION	(E) TC 198.95	TC 196.78
FLOWLINE ELEVATION	(E) FL 198.95	FL 196.78
GRADE BREAK		
ROAD CENTERLINE		
STORM DRAIN	SD	SD
AREA DRAIN		
CLEANOUT		
DROP INLET		
FINISH FLOOR ELEVATION		FFE197.00
FLOW DIRECTION		
SLOPE DIRECTION SOFTSCAPE	2.0%	2.0%
SLOPE DIRECTION HARDSCAPE	2.0%	2.0%
SPOT GRADE ELEVATION		71.3
STORM DRAIN MANHOLE		
TRENCH DRAIN		
PERFORATED UNDER DRAIN		UD
VEGETATED SWALE		
CONCRETE VALLEY GUTTER		
FOUNDATION PERIMETER DRAIN		PD
UTILITY SLEEVE		

SURFACING LEGEND

- BUILDING FOOTPRINT (1ST FLOOR)
- ASPHALT PAVEMENT (PER DETAIL 3/C5.0)
- ASPHALT OVERLAY (PER SPECS)
- CONCRETE PAVING (PER DETAIL 4/C5.0)
- CONCRETE PAVERS (PER DETAIL 1/C5.0)
- PLANTED AREAS (S.L.D.)
- RAIN GARDEN (PER DETAIL 8/C5.0)
- DETECTABLE WARNING SURFACE (SEE NOTE 3 THIS SHEET)
- VERTICAL CURB (PER DETAIL 2/C5.0)
- FLUSH CURB (PER DETAIL 5/C5.0)

DRAINAGE KEYNOTES

1. 230 LF (TOTAL) VEGETATED SWALE, S=1.0% MIN PER DET 9/C5.0, SWALE #1
2. STONE DRAIN OVER INFILTRATION TRENCH. SLOPE 4" PERF UD @ 1% MIN. S.L.D. SHT L1.6 FOR TRENCH WIDTH AND ALIGNMENT.

NOTES:

1. SEE SHEET C0.0 FOR GRADING AND DRAINAGE NOTES.
2. SEE LANDSCAPE DRAWINGS FOR SURFACING MATERIALS AND SOIL PREPARATION WITHIN ALL PLANTED AREAS, THE COURTYARD, BUILDING ENTRIES, AND PATIOS.
3. PER CITY REQUIREMENTS, DETECTABLE WARNING SURFACES SHALL BE INSTALLED AT NEW CONCRETE CURB RAMPS AND SHALL BE CAST-IN-PLACE IRON WITH BAKED-ON OIL FINISH, 18"X24", MANUFACTURED BY EAST JORDAN IRON WORKS AS INDICATED IN THE CONTRACT PLANS, DETAILS AND THE TECHNICAL PROVISIONS.

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Call: TOLL FREE
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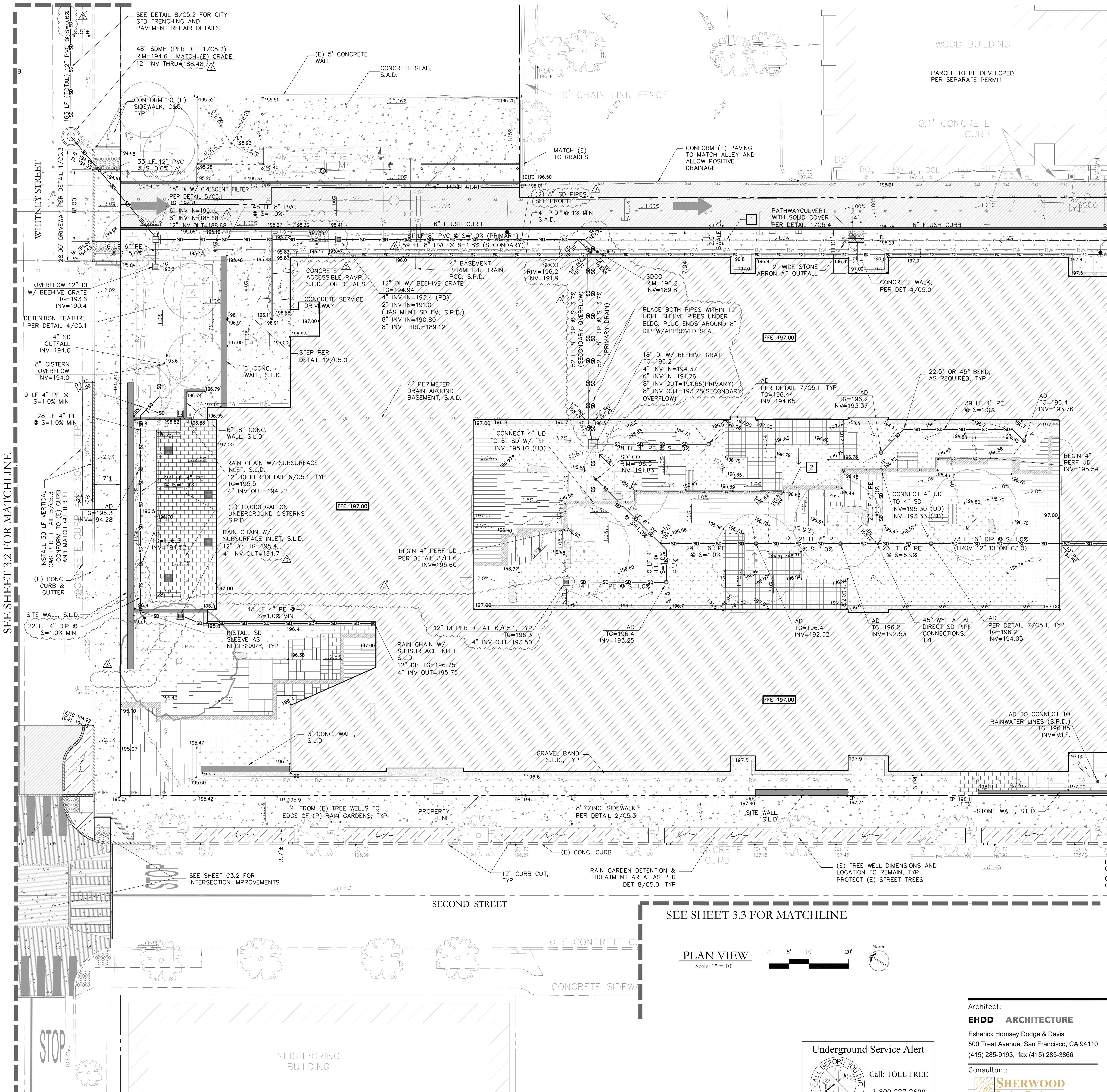
PACKARD FOUNDATION
343 SECOND STREET Los Altos, CA

Printing:	Date:	Revisions:	Date:
100% Schematic Design	09/18/08		
100% Design Development	06/17/09		
40% Construction Documents	05/06/10		
Permit Set	07/26/10		
100% Construction Documents	11/04/10		
Issued for Construction	12/09/10		

Stamp

Sheet Title:
GRADING & DRAINAGE PLAN
EXPANSION AREA

EHDD Job No.: 07023
Sheet No.:
File Location:
Drawn By: BW, IV
Scale: 1"=10'
C3.0



SEE SHEET 3.3 FOR MATCHLINE

PLAN VIEW
Scale: 1" = 10'

0 5' 10' 20'

North

DRAINAGE KEYNOTES

1. 230 LF (TOTAL) VEGETATED SWALE, S=1.0% MIN PER DET 9/C5.0, SWALE #1
2. SIDEWALK UNDERDRAIN (3"x12.5" RECTANGULAR CAST IRON PIPE) PER DETAIL 1/C5.1. CONNECT 12" DI TO UNDERDRAIN W/ 5 LF 6" DUCTILE IRON PIPE AND PIPE ADAPTOR.

NOTES:

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2. SEE SHEET C0.0 FOR GRADING AND DRAINAGE NOTES.
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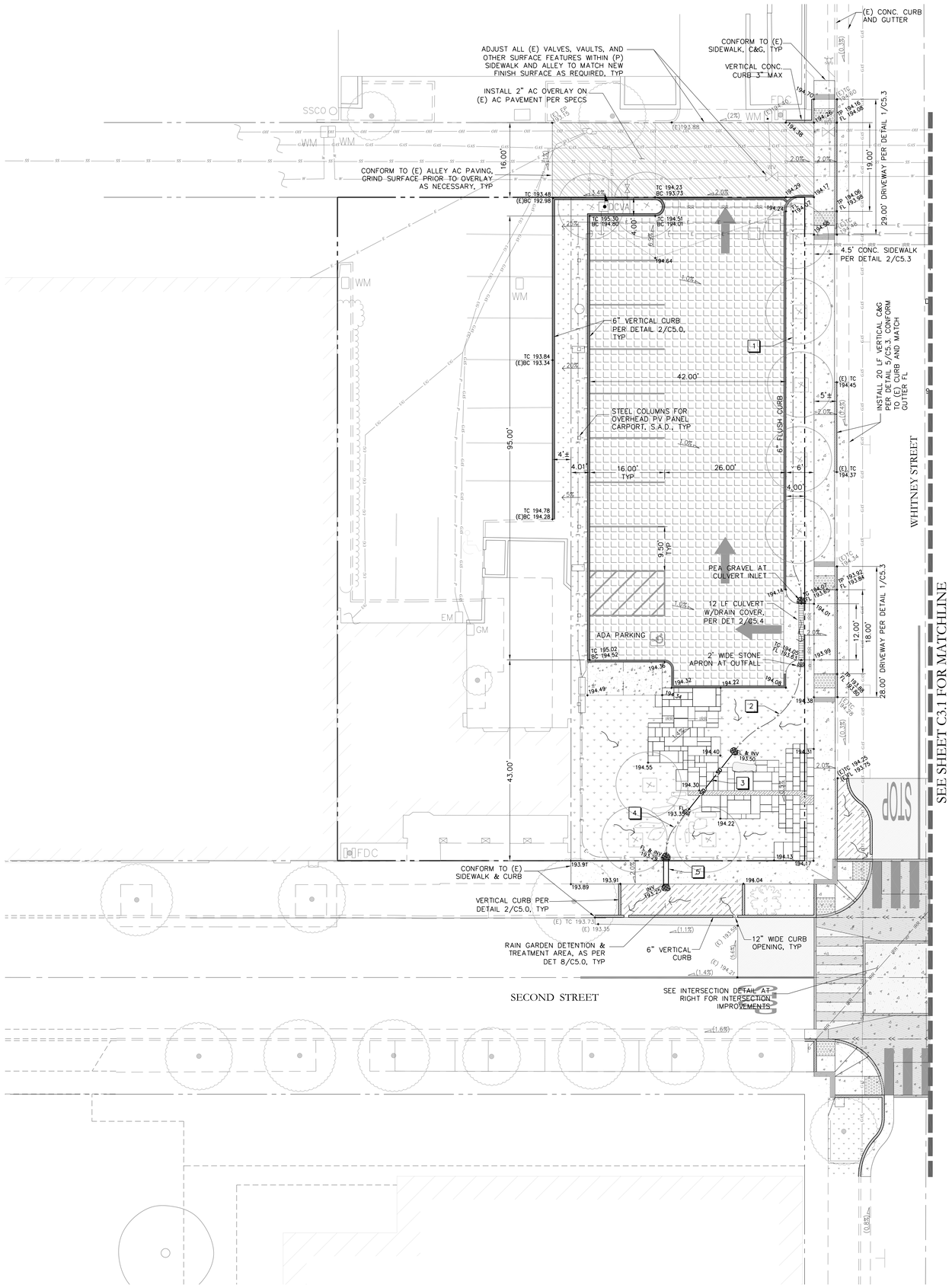
Sheet Title:
GRADING & DRAINAGE PLAN
BUILDING SITE

EHDD Job No.: 07023
File Location:
Drawn By: BW, IV
Scale: 1"=10'

Sheet No.:
C3.1



PLAN VIEW
Scale: 1" = 10'

0 5' 10' 20'

North

DRAINAGE KEYNOTES

1. 85 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #2
2. 26 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #2
3. 15 LF 4" PE SD, S=1.0% W/ PEA GRAVEL AT INLET AND 2' STONE APRON AT OUTFALL
4. 12 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #2
5. SIDEWALK UNDERDRAIN (3"x12.5" RECTANGULAR CAST IRON PIPE) @ S=0.5%, PER DETAIL 1/C5.1. W/ PEA GRAVEL AT INLET AND OUTLET

NOTES:

1. SEE SHEET C3.0 FOR LEGEND.
2. SEE SHEET C0.0 FOR GRADING AND DRAINAGE NOTES.
3. SEE LANDSCAPE DRAWINGS FOR SURFACING MATERIALS AND SOIL PREPARATION WITHIN ALL PLANTED AREAS, THE COURTYARD, BUILDING ENTRIES, AND PATIOS.
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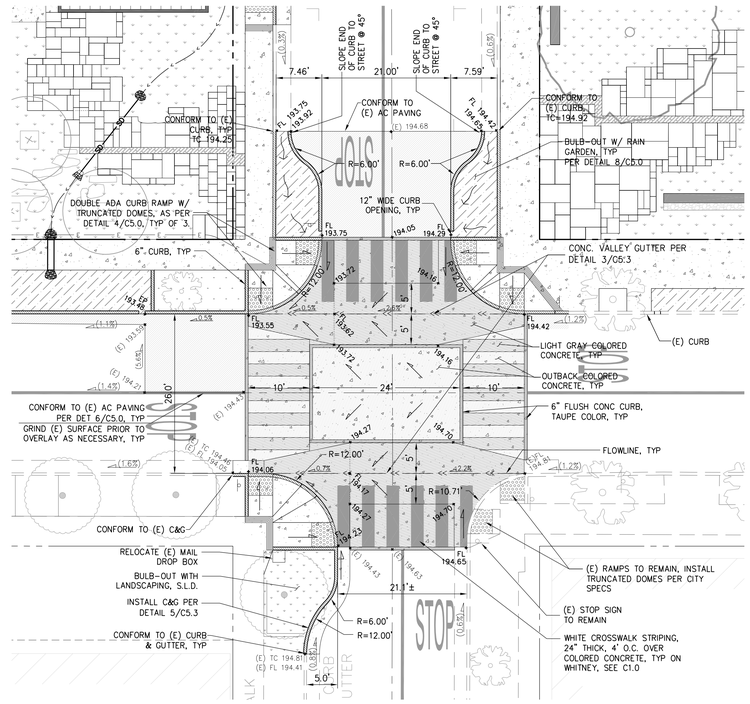

PLAN VIEW - INTERSECTION
Scale: 1" = 10'

NOTE: DESIGN APPROVAL OF INTERSECTION DESIGN DEFERRED AND SUBJECT TO A FINAL APPROVAL BY THE CITY OF LOS ALTOS.

INTERSECTION NOTES:

1. CENTER OF INTERSECTION TO BE PAVED WITH CONC. PAVERS PER SPECS.
2. VALLEY GUTTER AND CROSSWALKS SHALL BE COLORED PER CONCRETE SPECS.
3. SEE SHEET C1.0 FOR STRIPING & SIGNAGE INFORMATION.
4. SEE LANDSCAPE DRAWINGS FOR SOIL PREPARATION AND PLANTING WITHIN BULB-OUT RAIN GARDENS.

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Stamp: REGISTERED PROFESSIONAL ENGINEER, S. BRY SARTE, No.60244, EXP: 06/30/12, CIVIL, STATE OF CALIFORNIA

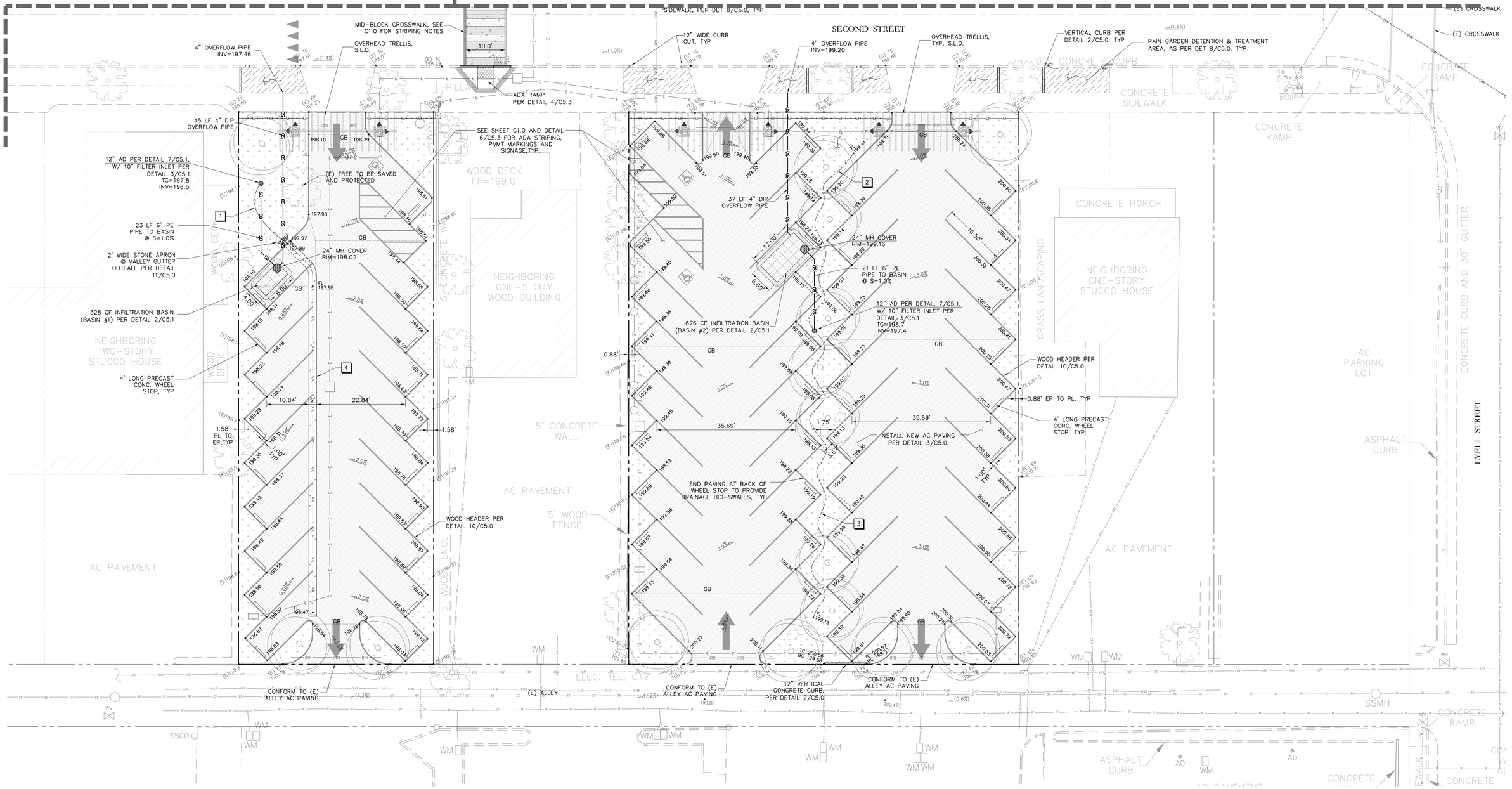
Sheet Title:
GRADING & DRAINAGE PLAN
VISITOR PARKING

EHDD Job No.: 07023
File Location:
Drawn By: BW, IV
Scale: 1"=10'

Sheet No.:
C3.2

SEE SHEET C3.1 FOR MATCHLINE

SEE SHEET C3.0 FOR MATCHLINE



PLAN VIEW
Scale: 1" = 10'

0 5' 10' 20'

North

DRAINAGE KEYNOTES

1. 20 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #3
2. 52 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #4
3. 83 LF VEGETATED SWALE, S=0.5% PER DETAIL 9/C5.0, SWALE #4
4. CONCRETE VALLEY GUTTER, S=0.6% MIN. PER DETAIL 7/C5.0

NOTES:

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100% Construction Documents	11/04/10		
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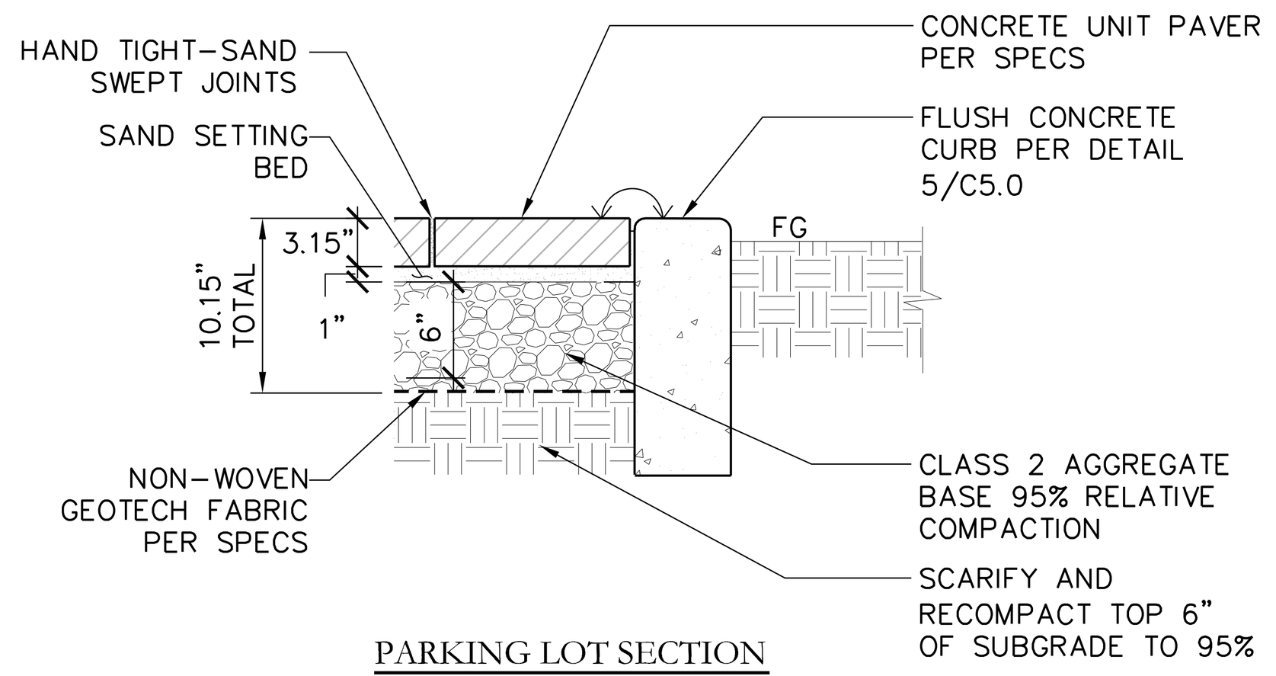
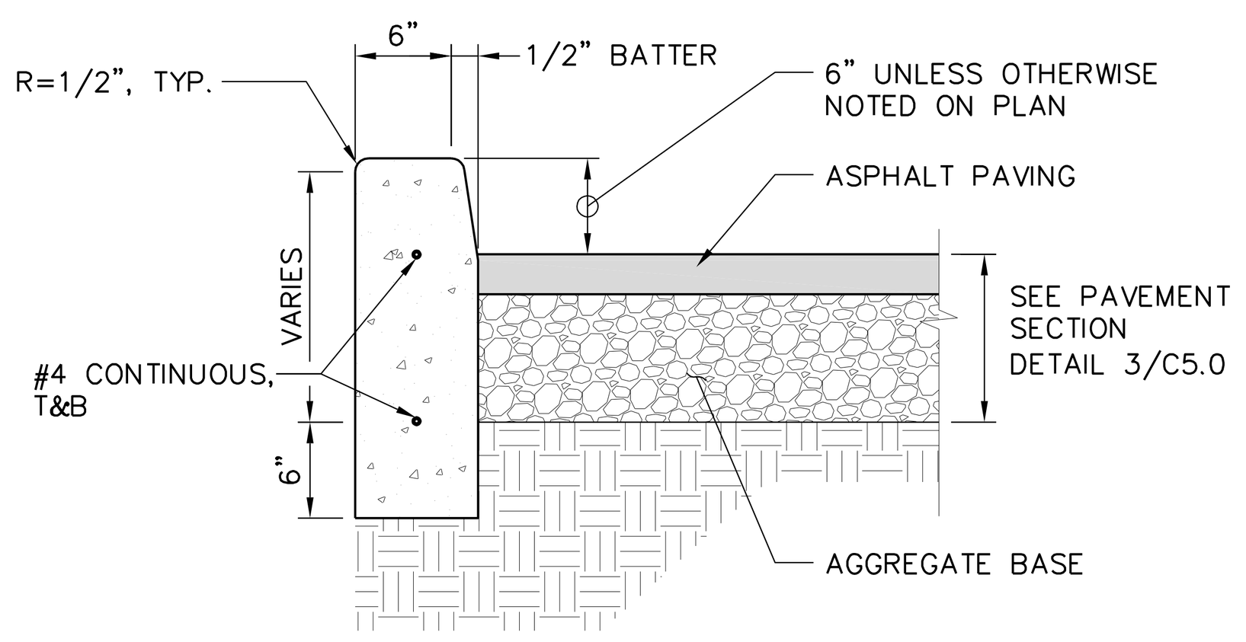
Sheet Title:
GRADING & DRAINAGE PLAN
SECOND ST. PARKING

EHDD Job No.: 07023
File Location:
Drawn By: BW, IV
Scale: 1"=10'

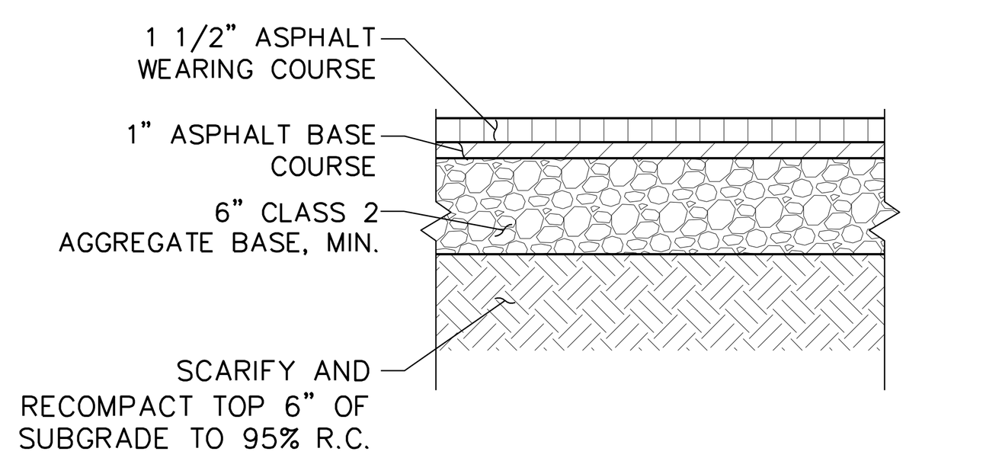
Sheet No.:
C3.3



1 C5.0 CONCRETE PAVER SECTION
SCALE: NTS



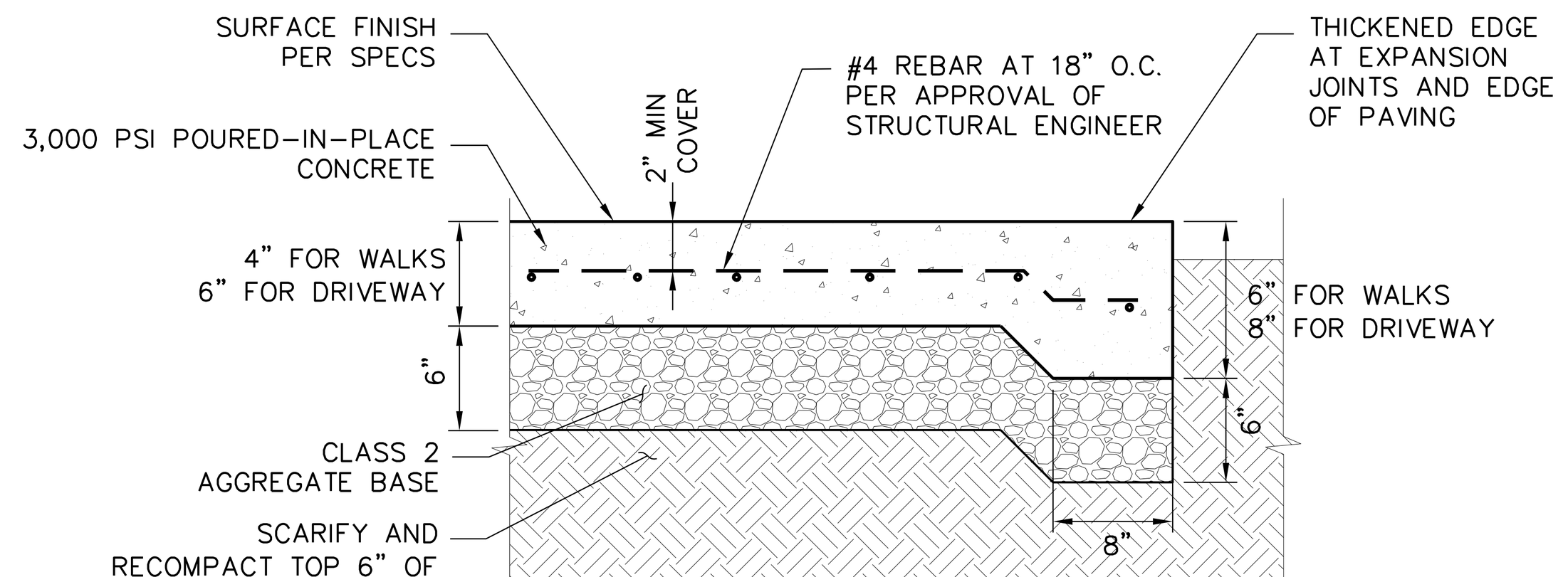
2 C5.0 VERTICAL CONCRETE CURB
SCALE: NTS



NOTE:
3" AC ON 9" AB FOR THE ALLEY EAST OF THE BUILDING AND PUBLIC STREET REPAIR.

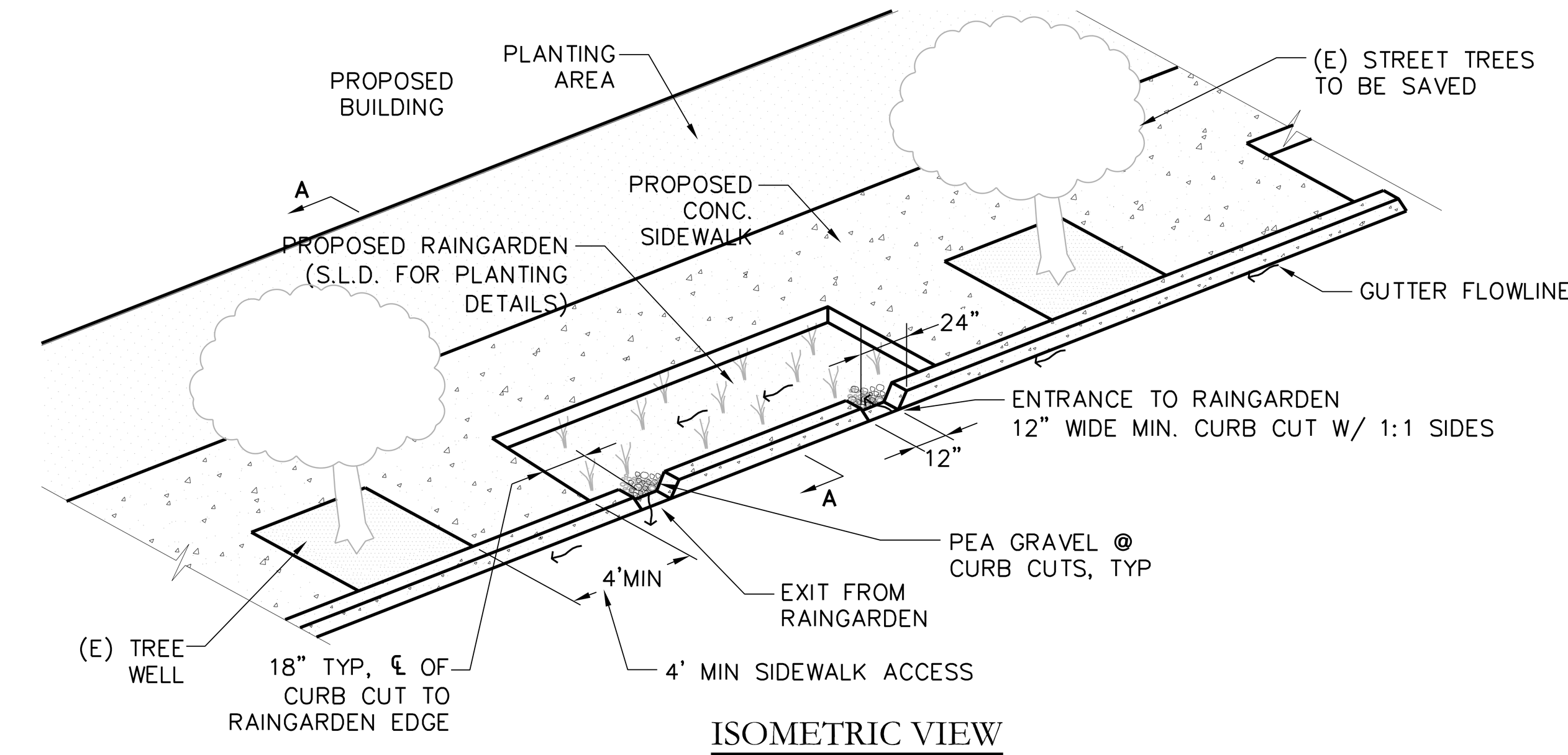
ADD ALT NO. 1:
INSTALL 1/16" TO 1/8" THICK POLYMER COMPOSITE MICRO-OVERLAY IN LIGHT GRAY COLOR OVER ASPHALT COURSE WITHIN ALL SECOND STREET PARKING LOTS AND ALLEY EAST OF BUILDING. REFER TO SPECS FOR MORE INFORMATION.

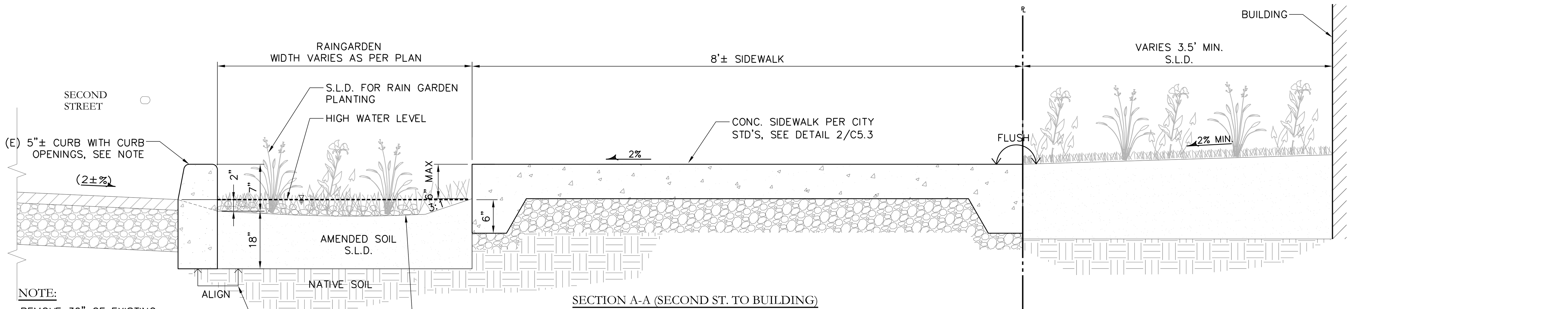
3 C5.0 ASPHALT SECTION
SCALE: NTS



NOTES
1. WHERE (E) SUBGRADE IS DETERMINED TO BE UNSUITABLE BY GEOTECHNICAL ENGINEER, INSTALL GEOTECH FABRIC BEFORE PLACING AB.
2. REFER TO THE SPECS FOR JOINTING AND INSTALLATION INFORMATION.

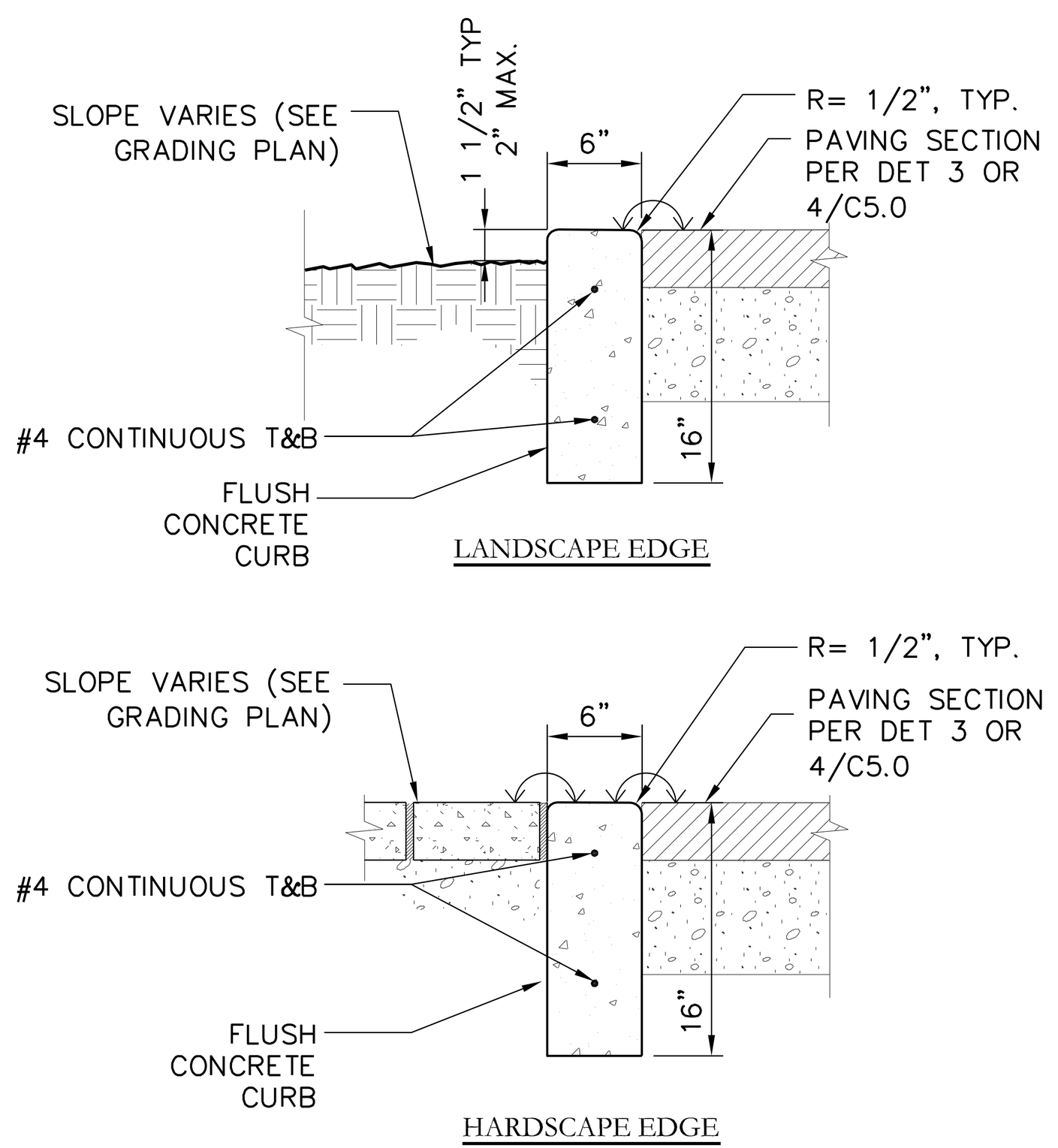
4 C5.0 CONCRETE SECTION
SCALE: NTS





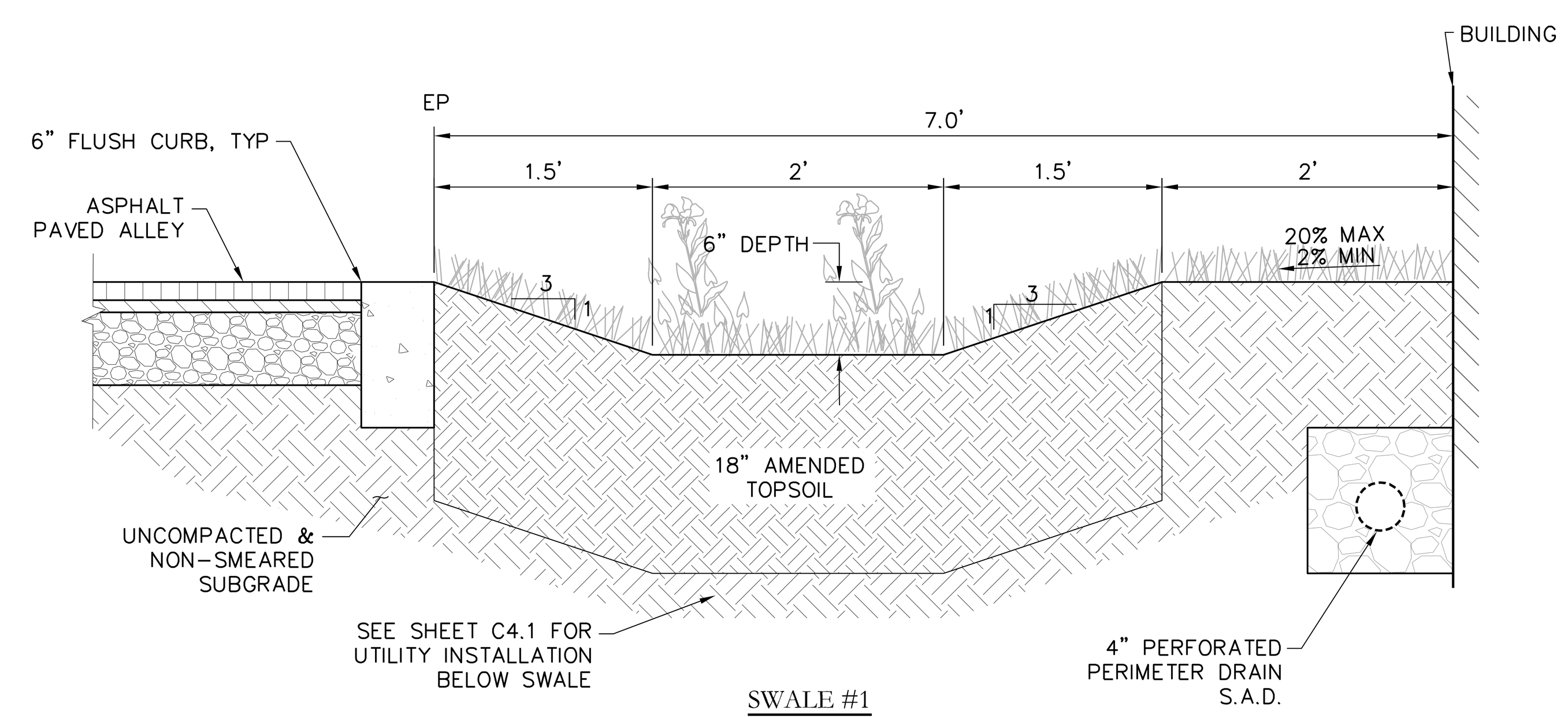
NOTE:
REMOVE 36" OF EXISTING CURB AND REPLACE TO INSTALL 12" WIDE CURB OPENINGS WITH 1:1 SIDES.

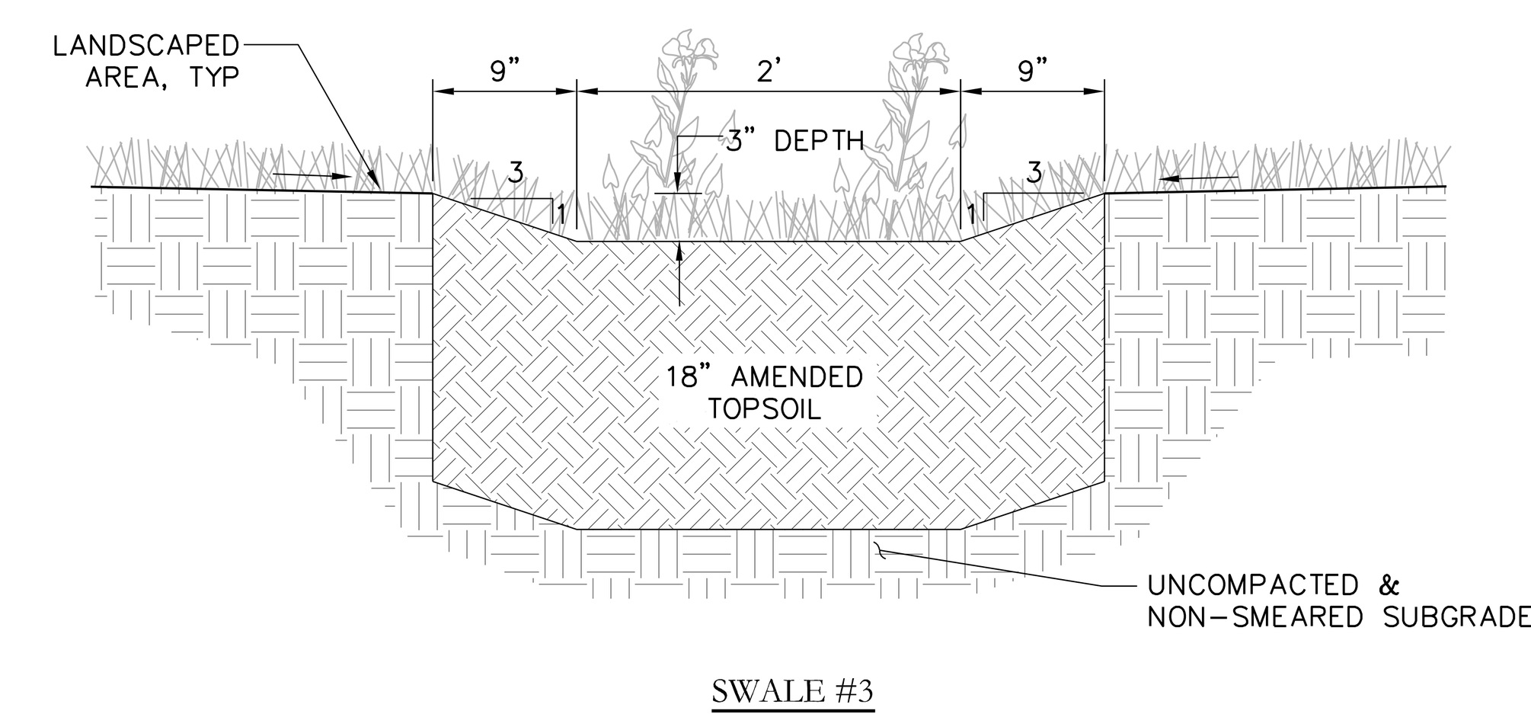
8 C5.0 CURBED RAIN GARDENS
SCALE: NTS

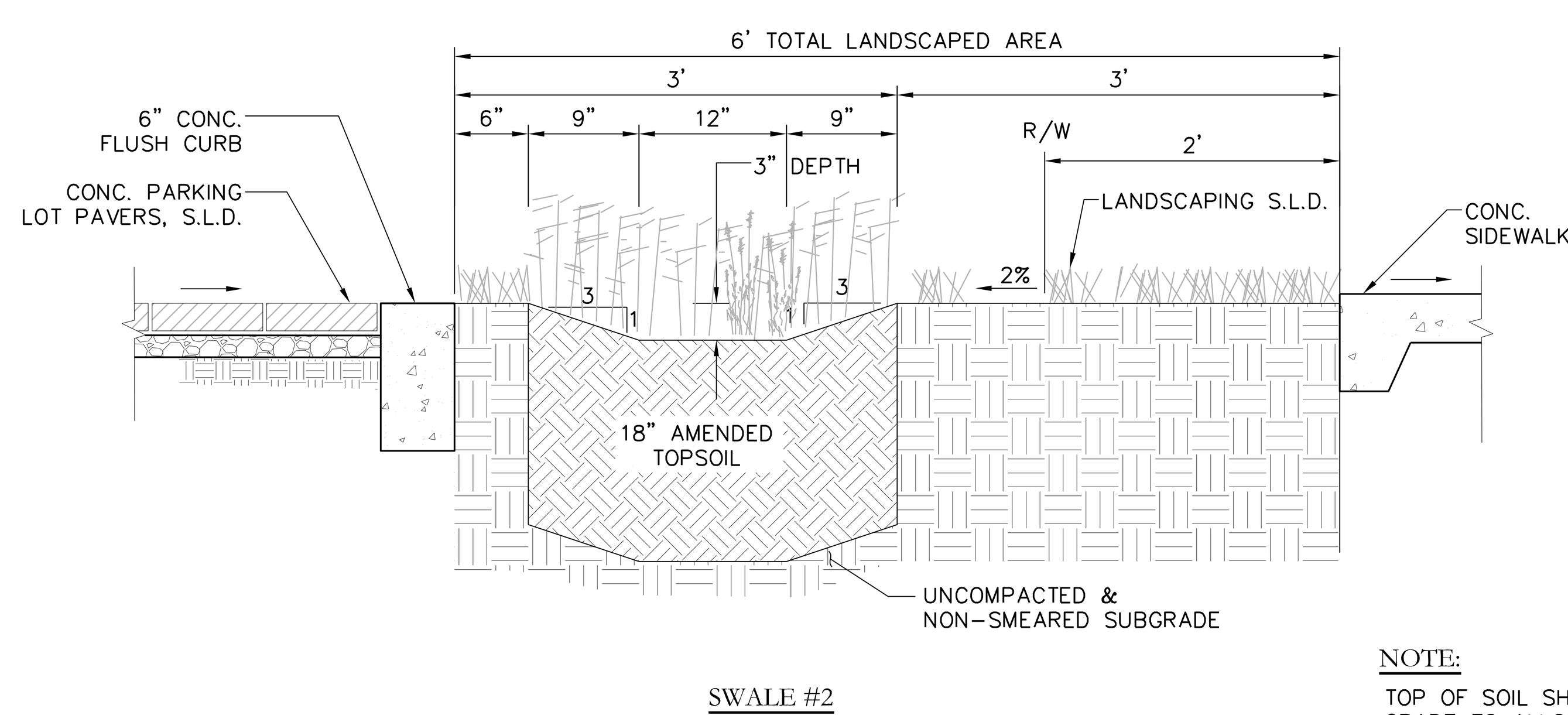


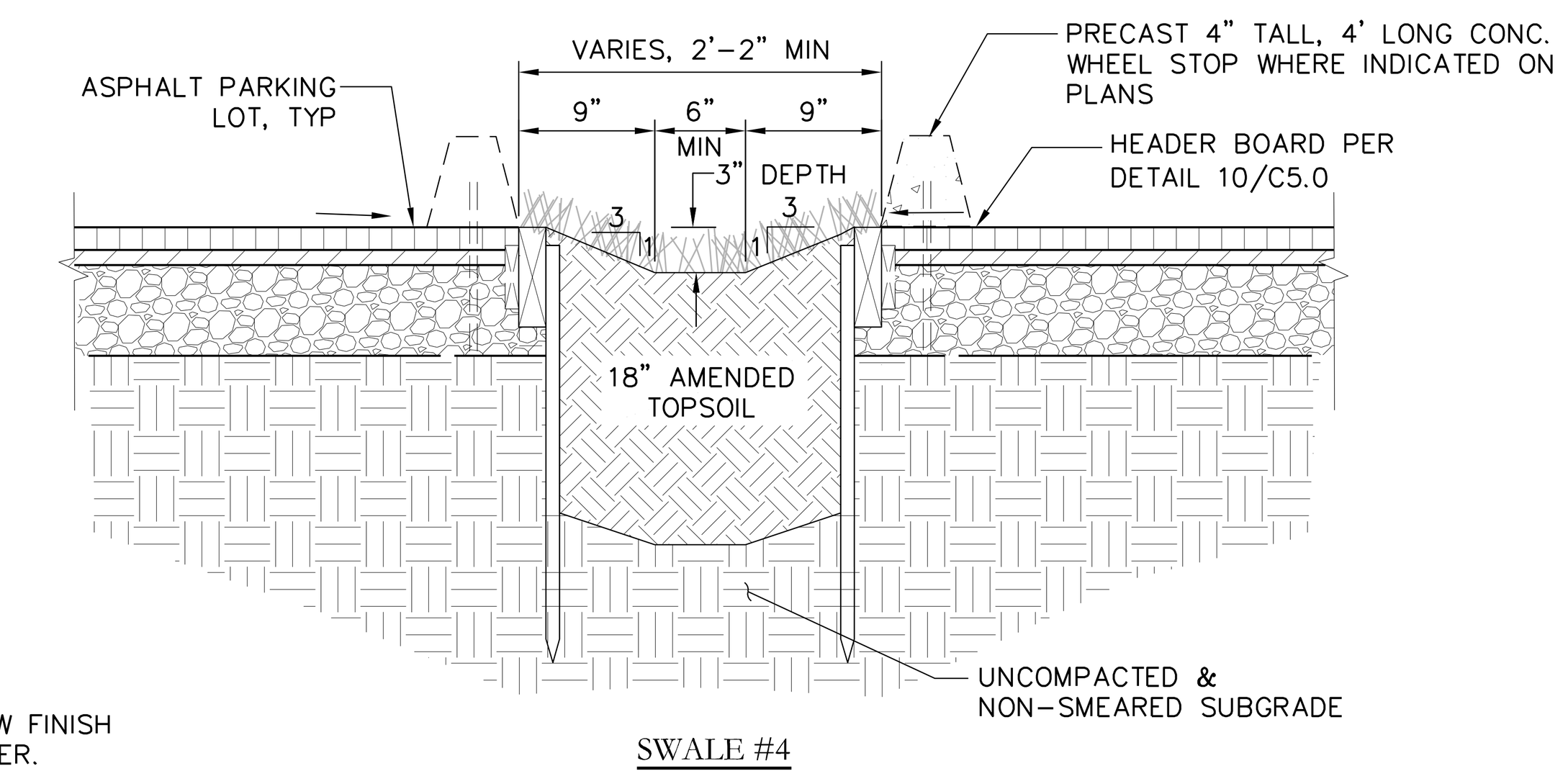
NOTES:
1. INSTALL CONTROL JOINT EVERY 15 FT, MIN.
2. INSTALL EXPANSION JOINT EVERY 45 FT, MIN.

5 C5.0 FLUSH CONCRETE CURB
SCALE: NTS



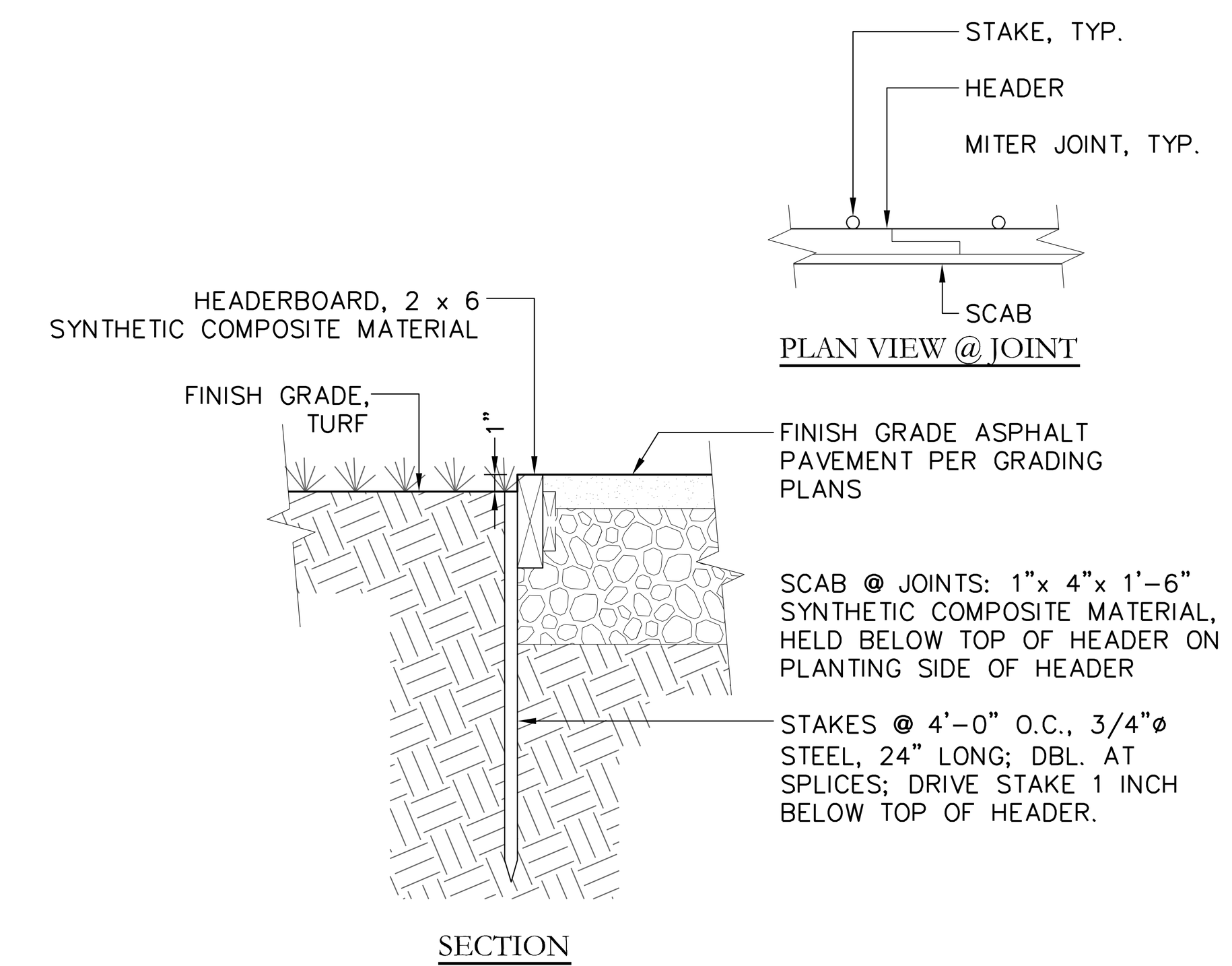




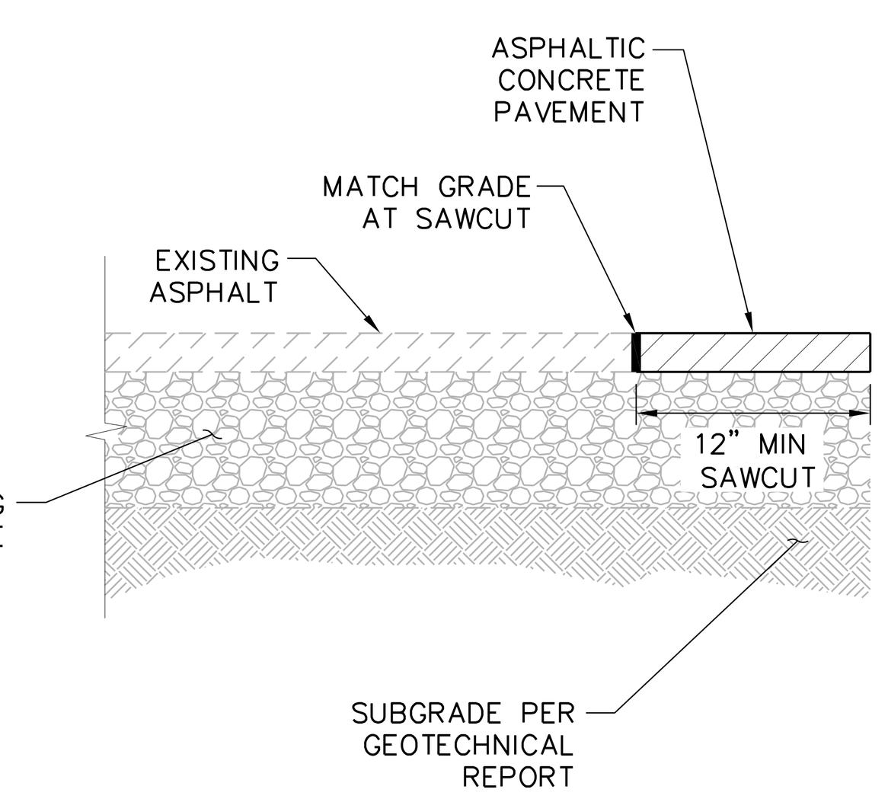


NOTE:
TOP OF SOIL SHOULD BE 2" BELOW FINISH GRADE TO ALLOW FOR MULCH LAYER. S.L.D. FOR MULCH PLACEMENT.

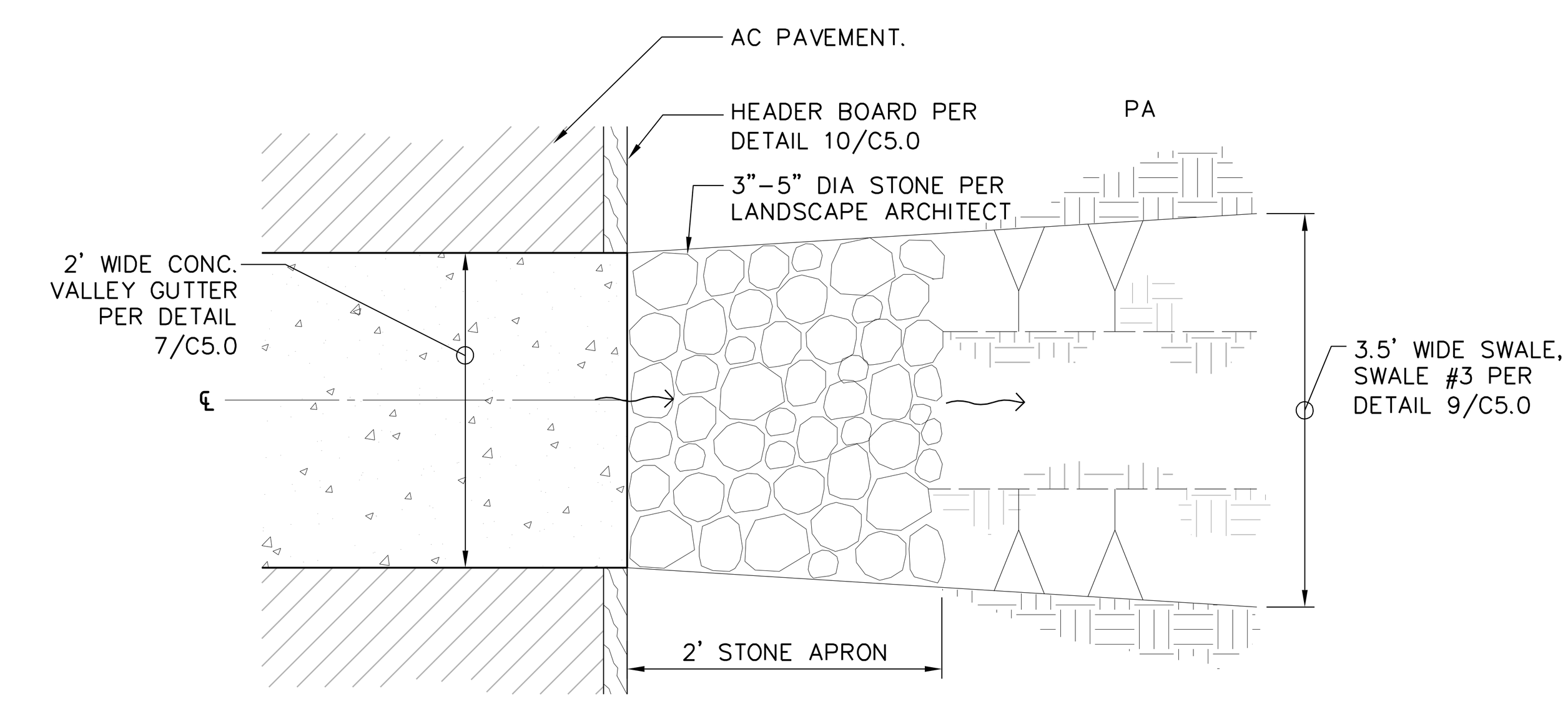
9 C5.0 VEGETATED SWALES
SCALE: NTS



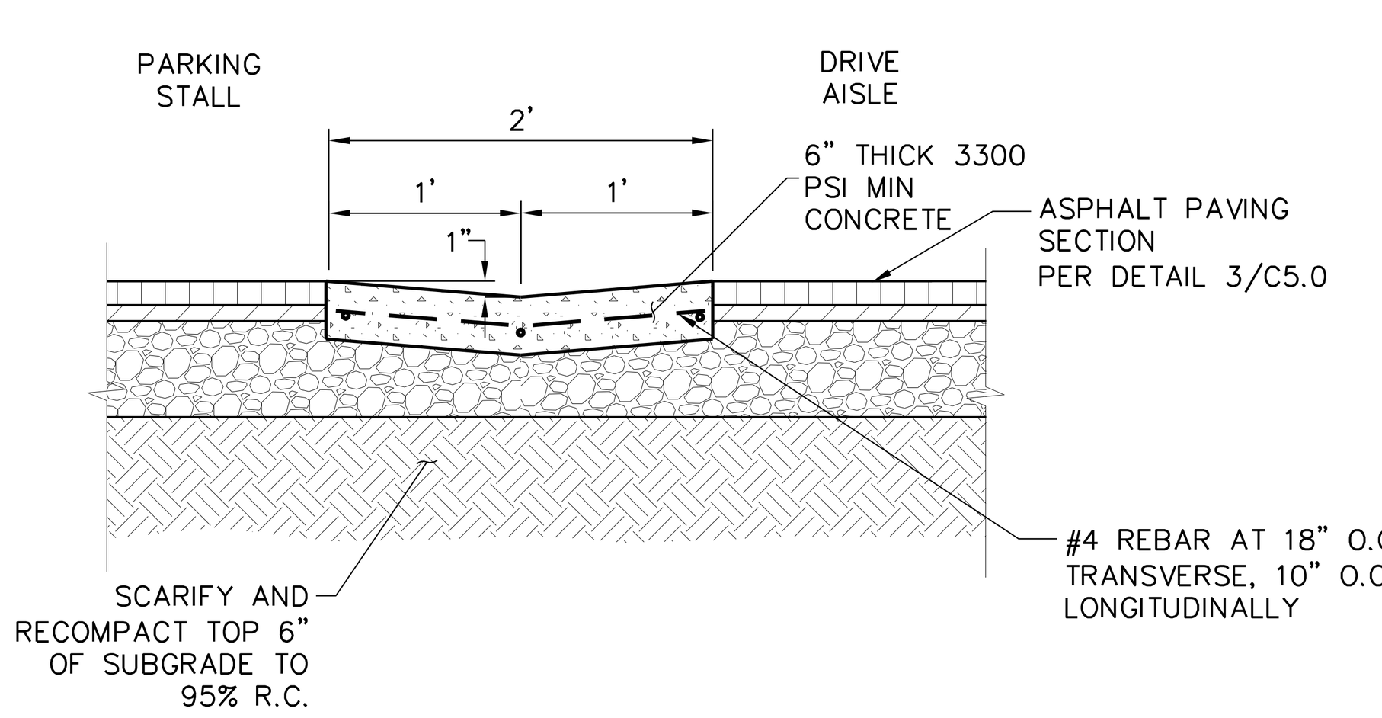
10 C5.0 HEADER BOARD
SCALE: NTS



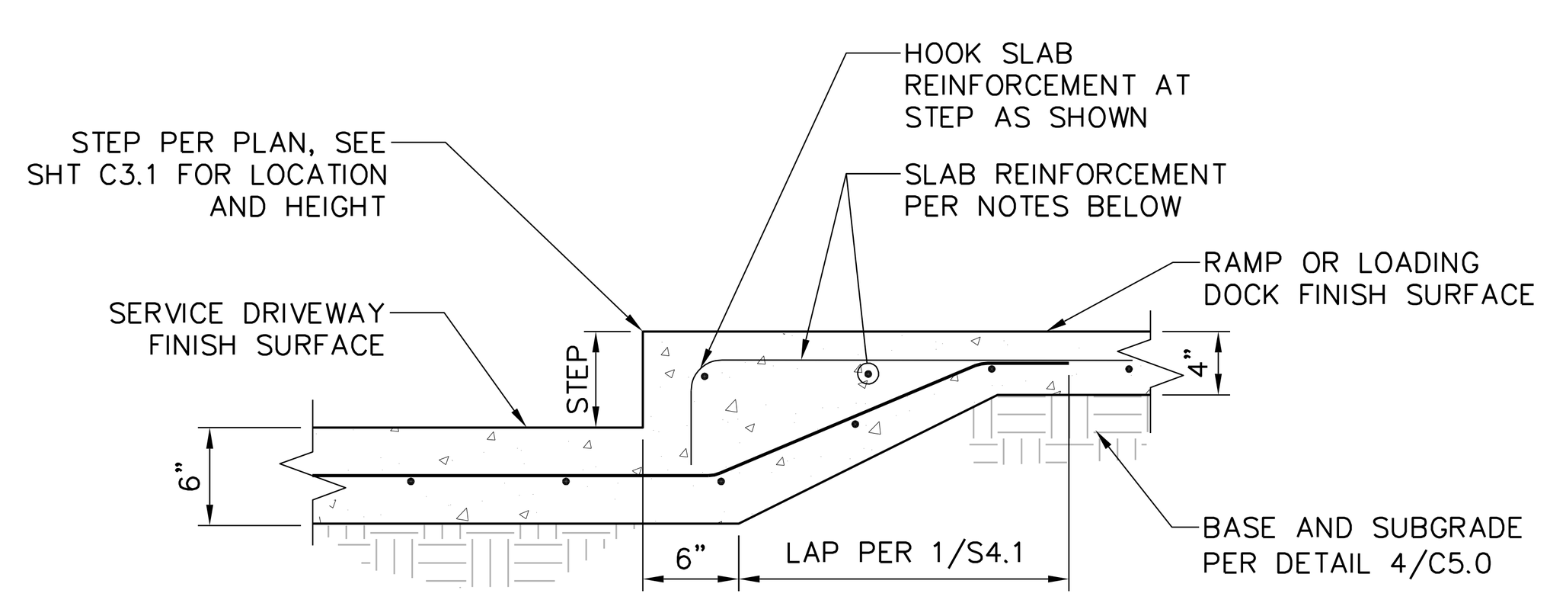
6 C5.0 PAVEMENT CONFORM
SCALE: NTS



11 C5.0 STONE APRON
SCALE: NTS



7 C5.0 PARKING LOT VALLEY GUTTER
SCALE: NTS



NOTE:
1. PROVIDE REINFORCEMENT PER THE FOLLOWING:
DRIVEWAY AND LOADING DOCK: #4 @ 12" O.C. BOTH WAYS.
PED RAMP: #4 @ 18" O.C. BOTH WAYS.
2. SEE SPEC 02751 FOR ALL OTHER CONCRETE REQUIREMENTS

12 C5.0 STEP AT SLAB-ON-GRADE
SCALE: NTS

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EXP. 06/30/12
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Sheet Title:
SITE AND DRAINAGE DETAILS

EHDD Job No.: 07023
File Location:
Drawn By: BW, IV
Scale: NTS

Sheet No.:
C5.0